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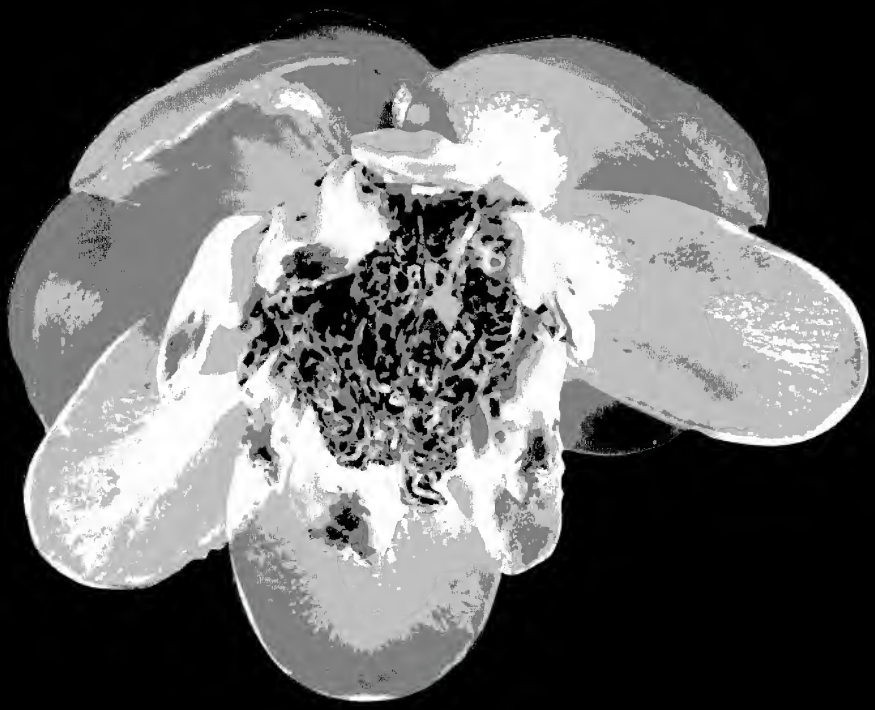

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A taxonomic revision of *Bridelia* Willd. (Euphorbiaceae) in Australia

Paul I. Forster

Summary

Forster, P.I. (1999). A taxonomic revision of *Bridelia* Willd. (Euphorbiaceae) in Australia. *Austrobaileya* 5(3): 405-419. The genus *Bridelia* Willd. is revised for Australia and contains five species, *B. exaltata* F.Muell., *B. finalis* P.I.Forst. sp.nov., *B. leichhardtii* Baill. ex Muell.Arg., *B. insulana* Hance and *B. tomentosa* Blume. All species are described and a key to distinguish them is provided. Distribution, habitat, typification, phenology and conservation status are outlined for each taxon.

Key words: *Bridelia exaltata*, *Bridelia finalis*, *Bridelia insulana*, *Bridelia leichhardtii*, *Bridelia tomentosa*, Australia, Euphorbiaceae

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Introduction

The genus *Bridelia* was named by Willdenow in 1806 with three species included in it at that time. The name commemorates S.E.Bridel ("in honorem Clariss S.E. Briedel nominavi" (Willdenow 1806: 979)). As outlined by Dressler (1996a), the name has been commonly spelt as `Bridelia' in many accounts ever since Sprengel (1818) `corrected' the spelling. The original spelling `Briedelia' was recently re-adopted in important reference works such as Chapman (1991), Greuter et al. (1993) and Webster (1994) and in a number of regional flora accounts and checklists (e.g. Dunlop et al. 1995; Forster & Henderson 1997). The spelling *Bridelia* has now been conserved (Brummitt 1998) and is used hereafter in the current paper.

An excellent overview of the genus *Bridelia* in Malesia and Indochina has recently been published by Dressler (1996c) who provided an extensive review of its taxonomic history and morphological variation. It is unnecessary to repeat here much of the information summarised in that paper, hence this introduction is brief.

Bridelia is included in the Euphorbiaceae subfamily Phyllanthoideae tribe Bridelieae, together with *Cleistanthus* Hook.f. ex Planch. (Webster 1994) from which it may be distinguished mainly by the drupaceous fruit and features of leaf venation (Dressler 1996c). Apart from the recent regional work of Dressler (1996b,c), major works on the genus as a whole have been published by Mueller (1866) and Jablonszky (1915).

In the present paper, a revision of the genus in Australia is presented as a precursor to the necessarily concise treatment to be eventually published in Volume 23 of the 'Flora of Australia'. This revision is necessary for several reasons -

(1) the account of Airy Shaw (1980b) is outdated and his key to taxa will not necessarily work with all Australian material,

(2) there are some slight changes needed to circumscription of taxa, especially in the *B. tomentosa* complex, and

(3) one new species requires description.

The first record of *Bridelia* from Australia was that of Baillon (1858) who published the nomen nudum *B. leichhardtii*. This name was subsequently validated by J. Mueller (1866) based on a type from Moreton Bay in Queensland. Meanwhile, F. Mueller (1862) had published *B. exaltata* F.Muell. for a different species in this genus based on a type from the Clarence River in New South Wales. J. Mueller (1866) in his monograph of the world's

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Euphorbiaceae, indicated *B. exaltata* and *B. tomentosa* Blume as occurring in Australia. Accounts of *B. exaltata*, *B. tomentosa* (with some collections also under the misapplied name *B. ovata*) and *B. leichhardtii* (under the synonymous name *B. faginea* (Baill.) F.Muell. ex Benth.) were included in *Bridelia* by Bentham (1873) who was more or less followed by Bailey (1902) and Jablonsky (1915). Apart from the descriptions of *B. tomentosa* var. *glabrata* Domin (now included in *B. tomentosa* var. *tomentosa*) (Domin 1927), and *B. phyllanthoides* W.V.Fitz. (now considered conspecific with *B. insulana*) (Fitzgerald 1918), little work was undertaken on the Australian representatives until Airy Shaw published his accounts in the 1970's and early 1980's.

In the most recent overall treatment of Australian *Bridelia*, Airy Shaw (1980b) included *B. exaltata*, *B. leichhardtii*, *B. penangiana* Hook.f. (now treated as conspecific with *B. insulana*) and *B. tomentosa*, this latter species including the varieties *B. tomentosa* var. *tomentosa*, *B. tomentosa* var. *glabrifolia* (Merr.) Airy Shaw, *B. tomentosa* var. *trichadenia* Muell.Arg. and *B. tomentosa* var. *eriantha* Airy Shaw. The recent accounts of Malesian species of *Bridelia* by Dressler (1996b,c) followed a paper by Li (1988) that established usage of the name *B. insulana* Hance for the taxon widely known in Australia as *B. penangiana*. Dressler (1996c) also provided detailed descriptions of both *B. insulana* and *B. tomentosa* based on extra-Australian collections.

Materials and Methods

This revision is based on herbarium collections at BRI, CANB, DNA, MEL, NSW, PERTH and QRS, as well as type material from other non-Australian herbaria. Types have been seen unless indicated as n.v. All species have been examined in habitat during the period 1979 to 1999. For species that are not endemic in Australia, only synonymy relevant to Australia is given and further synonyms may be located in Dressler (1996c). The spelling *Bridelia* is used throughout in the bibliographic sections, although in some cases it would have been spelt as *Briedelia*.

All descriptions are based on Australian collections. Floral descriptions were prepared from material preserved in spirit (FAA or 70% alcohol and 5% glycerol) or reconstituted by boiling in water and detergent. Fruit descriptions were prepared from material preserved in spirit or dried. Foliage and inflorescence descriptions were prepared from dried material. Indumentum cover is described using the terminology of Hewson (1988), except that 'scattered' is used instead of 'isolated'. The indumentum in Australian *Bridelia* species comprises uniseriate, multicellular hairs.

The 'Wet Tropics' is defined as that area of north-eastern Queensland that encompasses the 'hot, humid, vine forests' from near Cooktown in the north to Paluma in the south (Webb & Tracey 1981; Barlow & Hyland 1988). Rainforest typology follows Webb (1978).

Taxonomy

Bridelia Willd., Sp. Pl. 4(2): 978 (1806). **Type:** *B. scandens* (Roxb.) Willd. (lecto: fide Webster (1994: 39)). *Briedelia* Spreng., Anleit. Kenntn. Gew. ed. 2, 2: 887 (1818), orth. var. **Type:** not designated.

Shrubs or trees, rarely lianes, evergreen or rarely deciduous, perennial, dioecious or rarely monoecious; stems and foliage without obvious latex. Indumentum of multicellular uniseriate trichomes; stinging hairs absent; glandular hairs absent. Stipules entire or rarely divided, inconspicuous, caducous. Leaves alternate, petiolate, elobate, penninerved, entire or weakly sinuate or dentate, not glandular. Inflorescences axillary, glomerulate, bracteate. Male flowers sessile or shortly pedicellate; calyx lobes 5, valvate, partially connate at base; petals 5, alternate with sepals; disc present between the reproductive parts and the perianth, pulvinate and fleshy; stamens 5, with filaments united into a short column with upper parts free; anthers basifixed or dorsifixed, bilobate, with thecae oblong to ellipsoid, longitudinally dehiscent; pistillode topping the staminal column. Female flowers sessile to shortly pedicellate; perianth and disc as in male flowers but with an additional inner, membranous disc that surrounds the ovary; ovary 2- or 3-locular; locules biovulate; styles 2, free or united at

base, bifid. Fruits drupaceous, ellipsoid to globose, with surface smooth, indehiscent. Seeds 1 or 2 per fruit, ovoid to hemispherical, ecarunculate; testa smooth; albumen fleshy or membranous; cotyledons broad, flat.

A paleotropical genus of 50–60 species; five species in Australia.

Key to *Bridelia* species in Australia

1. Mature foliage with velutinous indumentum on lower surface ..... **2. B. finalis**
   Mature foliage without velutinous indumentum on lower surface 2
2. Leaf petiole black and tessellated; fruit 1-locular ..... **3. B. insulana**
   Leaf petiole green or brownish, smooth; fruit 2-locular 3
3. Leaf petiole rounded adaxially; sepals < 1.8 mm long ..... **5. B. tomentosa**
   Leaf petiole grooved adaxially; sepals 1.8–2 mm long 4
4. Leaf lamina with 13–18 lateral veins each side of midrib; fruit 8–13 mm diameter ..... **1. B. exaltata**
   Leaf lamina with 10–12 lateral veins each side of midrib; fruit 3–7 mm diameter ..... **4. B. leichhardtii**

1. Bridelia exaltata F.Muell., Fragm. 3: 32 (1862); *B. ovata* var. *exaltata* (F.Muell.) Muell.Arg. in DC., Prodr. 15(2): 495 (1866). **Type:** New South Wales. Clarence River, *Beckler* (holo: G-DC n.v. [fiche at BRI]).

[*Amanoa ovata* auct. non (Decne.) Baill.; Baillon, Adansonia 6: 336 (1866)].

***Illustrations*:** Francis (1981: 224, 225); Stanley (1983: 425, fig. 66A); Floyd (1989: 139); James & Harden (1990: 393); Hauser (1992: 128); Nicholson & Nicholson (1994: 17).

Shrub or small tree to 35 m high. Stems without prop roots, not buttressed. Bark ridged and fissured with corky plates although initially flat and nondescript, dark brown. Indumentum ferruginous to straw-coloured, generally deciduous. Young stems with sparse indumentum, soon glabrescent and lenticellate. Stipules linear, 3–4.5 mm long, 0.5–1 mm wide, usually deeply bifid, with sparse to dense indumentum. Leaves petiolate; petioles 5–10 mm long, 1.3–1.6 mm wide, grooved adaxially, same colour as lamina, with scattered indumentum; lamina elliptic, oblanceolate or obovate, up to 170 mm long and 60 mm wide with margins sinuate to weakly dentate and with distinct marginal vein; venation comprising 13–18 lateral veins per side of midrib and reticulate interlaterals; tip acute to shortly acuminate; base cuneate to rounded; upper surface glossy green, glabrescent, with lateral veins distinct and interlateral veins indistinct; lower surface glaucous green, with scattered indumentum mainly on veins or glabrescent and with lateral veins and midrib prominent and raised and interlateral veins prominent. Inflorescence with 1–5 flowers in clusters; bracts lanceolate to triangular, 0.8–1.5 mm long, 0.5–1 mm wide, with scattered indumentum. Male flowers pedicellate; pedicels 1.2–1.5 mm long, glabrous; sepals lanceolate-ovate, 1.8–2 mm long, 0.8–1 mm wide, glabrous; disc circular with a slightly undulating margin, 1.5–1.8 mm diameter; petals spathulate, c. 0.8 mm long and 0.7 mm wide; staminal column c. 0.5 mm long, with filaments 1.4–1.5 mm long, anthers ± ellipsoid, 0.6–0.7 mm long, c. 0.5 mm wide; pistillode 1–1.2 mm long, shortly bilobed. Female flowers not seen. Fruits 2–5 per cluster; 2-seeded, ellipsoid, 8–13 mm long, 8–13 mm wide, slightly pedicellate, white or yellow when immature, black or brown when fully ripe. *Brush Ironbark, Scrub Ironbark, Grey Birch, Brown Birch.* Fig. 1B.

***Selected additional specimens*: Queensland.** Wide Bay District: Bidwill, between Teddington & Maryborough, 25°36'S, 152°41'E, May 1994, *Smyrell* [AQ627901] (BRI); Pie Creek, Gympie district, Nov 1912, *Swain* 232 (BRI); Imbil, Jan 1918, *Weatherhead* 396 (BRI). Moreton District: Brisbane River, Dec 1908, *Bailey* [AQ201664] (BRI); Hyne Estate road, SE of Kandanga, 26°24'S, 152°42'E, Apr 1995, *Bean*

8526 (BRI, MEL, NSW); 4.5 km WSW of Mt Alford, 28°05'S, 152°33'E, Apr 1986, *Bird* [AQ399846] (BRI, CANB); Toowong - Indooroopilly, Brisbane, Mar 1932, *Blake & Everist* [AQ201669] (BRI); Beenleigh, s.dat., *Michael* 1822 (BRI); Indooroopilly, Jun 1889, *Simmonds* [AQ201665] (BRI); Flinders Peak, May 1961, *Smith* [AQ201670] (BRI); Myer's Ferry, Southport, Mar 1932, *White* [AQ201666] (BRI); Mt Alford, Apr 1949, *White* 13004 (BRI); Pine Mt, 12 km N of Ipswich, 27°32'S, 152°45'E, Jun 1978, *Williams* 78079 & *Bird* (BRI). **New South Wales.** Tumbulgum, Apr 1898, *Baker* (NSW); Ballina, Dec 1892, *Bauerlen* 943 (NSW); Rivertree area, c. 38 miles [63.3 km] E of Liston, 25 miles [41.7 km] NW of Tabulam, Jul 1969, *Clark* 1788 *et al.* (BRI, NSW); Mallangamee, Richmond River, Apr 1936, *de Beuzeville* (NSW); Casino, Mar 1917, *Irby* (NSW).

***Distribution and habitat*:** *B. exaltata* is endemic to Australia and occurs in south-eastern Queensland and north-eastern New South Wales (Map 1). The most northerly recorded locality for the species is at Teddington Weir and the most southerly locality at the Manning River (Floyd 1989). The species is to be found in notophyll vineforests (often with *Araucaria cunninghamii*) on a variety of soil types of volcanic or alluvial origins. Francis (1981), Floyd (1989), Hauser (1992) and Nicholson & Nicholson (1994) state that the fruit are eaten by birds.

***Phenology*:** Flowers have been recorded in May, November and December, and fruits from January to June.

***Notes*:** The type collection of *B. exaltata* was made by H. Beckler on the Clarence River in north-eastern New South Wales and was probably collected only a few years before Mueller described the species (F. Mueller 1862). The precise locality of the type collection cannot be determined, but there are modern collections from within this general area.

This species is poorly collected and I have not seen female flowers. It is often confused by collectors with large oblanceolate-leaved forms of *B. leichhardtii*. The two species may easily be distinguished by the number of lateral veins in the leaf lamina and the fruit size (see key to species). *B. exaltata* also grows in wetter vineforests than those where *B. leichhardtii* is found. Some localities given in Forster et al. (1991) for *B. exaltata* are referable to *B. leichhardtii* because they are based on misidentification of juvenile plants of the latter species.

***Uses*:** The wood of *B. exaltata* is suitable for building and turnery (Bailey 1888, 1902; Swain 1928; Francis 1981; Floyd 1989). Foliage of regrowth stems contains a prussic-acid yielding glycoside ("glucoside") that is poisonous to cattle (Francis 1981).

***Conservation status*:** The majority of collections of this species are more than 20 years old and it is rarely encountered in the remnants of vineforest that still exist in its known range. Despite this, it should not be regarded as a threatened species at this stage. It is present in at least seven conservation reserves in Queensland (Forster et al. 1991) and eight conservation reserves in New South Wales (Floyd 1989).

2. Bridelia finalis P.I.Forst. **sp. nov.** affinis *B. erapensi* S.Dressler sed foliis ellipticis, oblanceolatis vel obovatis (adversum folia ovata), folii lamina subtus brunneo-viridi, indumento velutino, sparso vel denso, stramineo vel ferrugineo (adversum folii laminam subtus griseo-viridem vel glaucam, indumentum puberulum sparsum brunneum) et bracteis inflorescentiae longioribus (2-3 mm adversum c. 1.3 mm longum) ab ea differens. **Typus:** Queensland. Cook District: c. 7 km S of Stone Crossing & 18 km E of Myerfield, 12°27'S, 142°09'E, 23 April 1991, *J.R. Clarkson* 9032 & *V.J. Neldner* (holo: BRI; iso: QRS).

Bridelia sp. (Stone Crossing *J.R.Clarkson*+ 9032), Forster & Henderson (1994: 109); Forster & Henderson (1997: 71)]

Small tree to 10 m high. Stems not buttressed and lacking prop roots at base. Bark nondescript, becoming tessellated, cream. Indumentum ferruginous to straw-coloured, generally deciduous. Young stems with dense indumentum, soon glabrescent and lenticellate. Stipules lanceolate, 2–4 mm long, 1–1.2 mm wide, entire, with dense indumentum. Leaves petiolate; petioles 3–6 mm long, 1.5–2 mm wide, rounded adaxially, same colour as lamina, with dense indumentum; lamina elliptic, oblanceolate

or obovate, up to 170 mm long and 95 mm wide with margins entire and slightly sinuate and with distinct marginal vein; venation comprising 9–15 lateral veins per side of midrib and reticulate interlaterals; tip shortly acute to rounded; base rounded or weakly cordate; upper surface glossy green, with scattered indumentum on veins or glabrescent, with lateral veins distinct and interlateral veins indistinct; lower surface brown-green, with velutinous, sparse to dense indumentum all over, with lateral veins and midrib prominent and raised and interlateral veins prominent. Inflorescence with numerous flowers in clusters; bracts lanceolate-ovate to triangular, 2–3 mm long, 1–2 mm wide, with dense indumentum. Male flowers subsessile to 0.5 mm long, the pedicels with dense indumentum; sepals lanceolate, 2–2.8 mm long, 0.8–1 mm wide, glabrous; disc circular with a slightly undulating margin, 2–2.2 mm diameter; petals spathulate, c. 0.8 mm long and 0.6 mm wide; stamens and pistillode not seen. Female flowers pedicellate to 0.5 mm; sepals and petals same as for male flowers; inner disc deeply lobed with irregular erose tips, 1–1.5 mm long; ovary not seen; styles 2, c. 1 mm long, bifid once. Fruits 2 or 3 per cluster, 2-seeded, ± globose, 5–6 mm long, 4–6 mm wide, pedicellate to 2 mm, pink-red when immature, red when fully ripe. Fig. 1E.

***Additional specimens*: Queensland.** COOK DISTRICT: Airstrip Scrub, 1.2 km SE of Kalpowar Homestead, Kalpowar Pastoral Holding, 14°53'S, 144°10'E, Nov 1992, *Fell* DGF2717 & *Stanton* (BRI); Browns Peak, 75 km ENE of Lakefield Homstead, Starcke Pastoral Holding, 14°37'S, 144°49'E, May 1993, *Fell* DGF3240 *et al.* (BRI, CANB); Upper Howick River, 49 km ENE of Lakefield Homestead, Kalpowar Pastoral Holding, 14°42'S, 144°35'E, May 1993, *Fell* DGF3252 (BRI, MEL); Schram Scrub, 16 km NW of Moreton Telegraph Station, Bertiehaugh Holding, 12°20'S, 142°32'E, Apr 1994, *Fell* DGF4251 & *Pritchard* (BRI, CANB, DNA, QRS); 'Equina Scrub', 42 km W of Coen, Holroyd Pastoral Holding, 13°59'S, 142°48'E, Jun 1994, *Fell* DGF4402 & *Buck* (BRI, QRS); Bathurst Range, 19 km SSE of Bathurst Head, 14°25'S, 144°15'E, Jul 1994, *Fell* DGF4486 *et al.* (BRI, DNA, QRS); Possum Scrub, Weipa to Stones Crossing road, 12°27'S, 142°09'E, Jul 1993, *Forster* PIF13518A *et al.* (BRI, QRS); ditto, Jun 1994, *Forster* PIF15269 & *Tucker* (BRI, QRS); Mary Valley Scrub, 15°02'S, 143°45'E, Jul 1993, *Forster* PIF13441 *et al.* (BRI, QRS); Mt White, Coen, Jun 1996, *Forster* PIF19447 (BRI, QRS).

***Distribution and habitat*:** *B. finalis* is endemic to Cape York Peninsula, Queensland (Map 3). The species grows in deciduous vinethicket on rocky slopes derived from quartzitic granites or on hard, red lateritic ridges.

***Phenology*:** Flowers at anthesis have not been seen and they are probably present from December to February. Plants at Possum Scrub were examined in late November after extensive storm rain but still had only buds present. Ripe (or nearly so) fruit have been collected in April.

***Notes*:** This new species was first collected in 1991 by J.R. Clarkson and V.J. Neldner and there have been few subsequent collections made.

B. finalis is superficially similar to the recently described *B. erapensis* S.Dressler from Morobe Province in Papua New Guinea and will key to that species in Dressler's key (Dressler 1996b). Both taxa are poorly known with complete morphological data for the flowers of both species lacking. Based on the available material, *B. finalis* differs from *B. erapensis* in its leaves being elliptic, oblanceolate or obovate (rather than ovate), the undersurface of its leaf lamina being brown-green, with velutinous, sparse to dense, straw to ferruginous coloured indumentum (rather than the undersurface of the leaf lamina being grey-green to glaucous, with puberulous, sparse, brown coloured indumentum), and longer inflorescence bracts (2–3 mm rather than c. 1.3 mm). *B. finalis* also has coriaceous leaves (pers. obs. of live plants) whereas *B. erapensis* is described by Dressler has having chartaceous to subcoriaceous leaves. It is difficult to determine from the two herbarium collections of *B. erapensis* available to me (duplicates at BRI of Hartley 12224 and Henty NGF10692) whether this is a genuine additional distinction, but the New Guinean species does seem to be a less robust plant in terms of its foliage. The two species are undoubtedly closely allied and further collections may well reveal that they are conspecific.

The localities recorded for *B. erapensis*, although encompassing "lowland monsoon or rain forests" (cf. Dressler 1996c) (notophyll vineforests), are not subjected to the extremes

of dry-season water deficiency found where *B. finalis* grows on Cape York Peninsula. The vineforests where *B. erapensis* occurs have a well-developed ground and epiphyte flora (pers. obs. 1992). By contrast, habitats for *B. finalis* have little in the way of a ground flora and epiphytes are few.

***Uses*:** No uses have been recorded for this species. It grows large enough in some situations to produce millable timber and could be useful for turnery.

***Conservation status*:** *B. finalis* is widespread on Cape York Peninsula but infrequently collected. It is superficially similar to *Cleistanthus peninsularis* Airy Shaw and some taxa of Annonaceae and is likely to be overlooked by the majority of collectors. No conservation coding is considered necessary at this stage.

***Etymology*:** The specific epithet is formed from the Latin *finalis* (of the end) and reflects the author's concept of species delimitation in the Australian taxa of *Bridelia*.

3. Bridelia insulana Hance, J. Bot. 15: 337 (1877). **Type:** Cochinchina, in ins. Phukok, Feb 1874, *Pierre* 19762 (holo: BM n.v. (fide Dressler (1996c: 315); iso: K n.v. (fide Dressler (l.c.), P n.v. [photo at BRI]).

Bridelia penangiana Hook.f., Fl. Brit. India 5: 272 (1887). **Type:** Malaysia. Penang, Government Hill, 1885, *C. Curtis 527* (holo: K n.v. [photo at BRI]).

Bridelia minutiflora Hook.f., Fl. Brit. India 5: 273 (1887). **Type:** Burma. Tenasserim, Mergui, *Griffith* 867 (holo: K n.v. [photo at BRI]).

***Illustrations*:** Christophel & Hyland (1993: 98, plate 36h); Cooper & Cooper (1994: 59).

Shrub or small tree to 10 m high. Stems buttressed with prop roots at base, often with 'spines' (immature prop roots) on lower trunk. Bark nondescript, becoming tessellated and flaky, cream. Indumentum ferruginous to straw-coloured, generally deciduous. Young stems with sparse to dense indumentum, soon glabrescent and lenticellate. Stipules linear-oblong to lanceolate, 2.5–5.5 mm long, 1–1.2 mm wide, entire, with dense indumentum. Leaves petiolate; petioles 6–9 mm long, 1–1.8 mm wide, rounded adaxially, black & tessellated, with scattered indumentum; lamina elliptic to obovate, up to 230 mm long and 90 mm wide with margins entire and slightly sinuate and with distinct marginal vein; venation comprising 10–13 lateral veins per side of midrib and reticulate interlaterals; tip shortly acuminate to obtuse; base cuneate to rounded; upper surface glossy green, glabrescent, with lateral veins distinct, interlateral veins indistinct; lower surface pale brownish-green and with scattered indumentum mainly on veins, lateral veins and midrib prominent and raised and interlateral veins prominent. Inflorescence with numerous flowers in clusters; bracts lanceolate-ovate, c. 1.5 mm long and 1 mm wide, with sparse indumentum. Male flowers pedicellate, to 0.5 mm long, with sparse to dense indumentum; sepals lanceolate-ovate to triangular, 1–1.5 mm long, 0.7–1 mm wide, glabrous; disc circular with a slightly undulating margin, 1–1.6 mm diameter; petals spathulate to suborbicular with the tip crenate, 0.4–0.5 mm long, 0.3–0.5 mm wide; staminal column 0.6–0.7 mm long with filaments 0.7–0.9 mm long, anthers ±ellipsoid, 0.4–0.5 mm long, 0.4–0.5 mm wide; pistillode 0.3–0.4 mm long, shortly bilobed. Female flowers ±sessile, sepals and petals same as for male flowers; inner disc of irregular lobing c. 0.5 mm long; ovary ellipsoid, c. 0.5 mm long, 0.3–0.5 mm wide, glabrous; styles 2, 1.2–1.5 mm long, bifid. Fruits 5–12 per glomerule, 1-seeded, ellipsoid, 5–10 mm long, 3–6 mm wide, subsessile, pink-green when immature, red to purple-black when fully ripe. Fig. 1C.

***Selected additional specimens*: Queensland.** Cook District: Rocky River Scrub, Silver Plains, 13°48'S, 143°28'E, Jul 1993, *Forster* PIF13644 *et al.* (BRI, MEL, QRS); S.F.R. 310, Parish of Gadgarra, Goldsborough L.A., 17°13'S, 145°46'E, Jan 1985, *Gray* 3853 (QRS); Eubenangee Swamp, near Babinda, 17°20'S, 145°55'E, Oct 1969, *Hyland* [AQ201719] (BRI); Claudie River, between the camp & the airport, 12°50'S, 143°20'E, Oct 1972, *Hyland* RFK2711 (BRI, NSW, QRS); Claudie River, 12° 45'S, 143°15'E, Oct 1973, *Hyland* 7003 (BRI, QRS); ditto, Oct 1974, *Hyland* 7801 (BRI, QRS); Cairns Botanic Gardens, Red Arrow Walk, 16°54'S, 145°45'E, Jun 1976,

Hyland RFK3437 (BRI, QRS); Porn. 195 Parish of Clerk, Nov 1983, *Hyland 12908* (QRS); NE side of Lamond Hill, Iron Range, 12°43'S, 143°18'E, Nov 1986, *Jessup* 783 (BRI); Cairns, Currunda Creek, 16°56'S, 145°41'E, Jan 1992, *Lyons* 107 (BRI); South Mossman River, 16°29'E, 145°23'E, Sep 1987, *Sankowsky* 645 (BRI); Mossman River, 1886, *Sayer* [AQ201717] (BRI); Oliver Creek, Cape Tribulation area, 16°06'S, 145°27'E, May 1972, *Webb & Tracey* 11583 (BRI); Between Stony Point & Mosquito Point, 12°25'S, 143°16'E, Dec 1977, *Webb & Tracey* 13848 (BRI); Little Mulgrave, 17°08'S, 145°42'E, Jan 1954, *White* [AQ201722] (BRI). NORTH KENNEDY DISTRICT: Mission Beach, 17°52'S, 146°07'E, Oct 1967, *Hyland* 1182 (BRI).

***Distribution and habitat*:** *B. insulana* occurs in north-eastern Queensland in a number of disjunct localities in the Wet Tropics and on Cape York Peninsula (Map 2). It is also widespread in Malesia and the Indian subcontinent (Dressler 1996c). Plants grow in notophyll or mesophyll vineforest on alluvium or volcanic soils.

***Phenology*:** Flowers have been recorded mainly from October to December, but there are occasional records from other months. Fruits have been recorded mainly from December to April, but there are occasional records from other months.

***Notes*:** This species was first recorded for Australia as *B. minutiflora* Hook.f. by White (1936) based on collections by Sayer from the Mossman River area and Ladbrooke from the Johnstone River area. Airy Shaw (1976, 1980a,b) included the species under *B. penangiana* Hook.f. Dressler (1996b,c), following a paper by Li (1988), included both *B. minutiflora* and *B. penangiana* in synonymy with *B. insulana* Hance.

Dressler (1996b), in his key to New Guinean *Bridelia* species, stated that *B. insulana* lacks a distinct marginal vein in its leaves. All of the Australian and extra-Australian material I have seen of this taxon definitely has a marginal vein in the leaves, hence this character should be deleted from Dressler's key.

***Uses*:** The species rarely grows large enough to produce millable timber. There are no uses recorded for it.

***Conservation status*:** Common and widespread.

4. Bridelia leichhardtii Baill. ex Muell.Arg. in DC., Prodr. 15(2): 499 (August 1866) [as 'Bridelia leichhardi']. **Type:** Queensland. MORETON DISTRICT: nr Camerons brush, Moreton Bay, 1844, *Leichhardt* (holo: P n.v. [photo at BRI]).

Amanoa faginea Baill., Adansonia 6: 336 (Sept 1866); *Bridelia faginea* (Baill.) Benth., Fl. Austral. 6: 120 (1873). **Type:** Queensland. PORT CURTIS DISTRICT: Rockhampton, 1863, *Dallachy* 17 (syn: MEL); Frenchmen Creek, 1863, *Dallachy* 259 (syn: MEL); Rockhampton, *Thozet* 76 & 172 (syn: MEL).

Bridelia melanthesoides var. *australiensis* Gehrm., Bot. Jahrb. 91, Beibl. 95: 35 (1908). **Type:** not designated.

Bridelia leichhardtii var. *glabrata* Domin, Biblioth. Bot. 89: 325 (1927) [as 'Bridelia leichardti']. **Type:** Queensland. PORT CURTIS DISTRICT: "Emu Park bei Rockhampton", Mar 1910, *Domin* (holo: ?PR n.v.).

***Illustrations*:** Williams (1987: 47); Hauser (1992: 129).

Shrub or small tree to 6 m high. Stems without prop roots, not buttressed. Bark ridged and fissured, with corky plates, blackish. Indumentum ferruginous to straw-coloured, generally deciduous. Young stems with sparse to dense indumentum, soon glabrescent and lenticellate. Stipules linear, 1–1.5 mm long, 0.2–0.3 mm wide, entire, with sparse to dense indumentum. Leaves petiolate; petioles 2–5 mm long, 0.3–0.5 mm wide, grooved adaxially, same colour as lamina, with scattered to sparse indumentum; lamina elliptic, oblanceolate, obovate or rarely suborbicular, up to 100 mm long and 45 mm wide with margins entire to weakly dentate and without distinct marginal vein; venation comprising 10–11 lateral veins per side of midrib and reticulate interlaterals; tip acute to rounded; base cuneate to rounded; upper surface glossy green, glabrescent, with lateral veins distinct and interlateral veins indistinct; lower surface pale brownish-green,

with scattered indumentum mainly on veins, lateral veins and midrib prominent and raised and interlateral veins prominent. Inflorescence with 1 or 2 flowers in clusters; bracts lanceolate to triangular, 0.5–0.7 mm long, 0.5–0.7 mm wide, with sparse indumentum. Male flowers subsessile or pedicellate; pedicels to 1 mm long, glabrous; sepals lanceolate, 1.5–2 mm long, 0.8–1 mm wide, glabrous; disc circular with a slightly undulating margin, c. 1.5 mm diameter; petals spathulate with the tip crenate, 0.5–0.8 mm long, 0.5–0.8 mm wide; staminal column 1–1.2 mm long with filaments 0.5–0.8 mm long, anthers roughly ellipsoid, 0.4–0.6 mm long, 0.3–0.5 mm wide, pistillode 0.5–0.8 mm long, shortly bilobed. Female flowers ±sessile, sepals and petals same as for male flowers; inner disc of 4 or 5 lobes 0.8–1 mm long that almost totally enclosing the ovary with margins irregularly erose; ovary ellipsoid, 1.8–2 mm long, 1.5–2 mm wide, glabrous; styles 2, 0.4–0.5 mm long, bifid. Fruits 1 or 2 per cluster; 2-seeded, globose, 3–7 mm long, 3–7 mm wide, slightly pedicellate, red when immature, black or purple-black when fully ripe. *Scrub Ironbark, Small-leaved Brush Ironbark*. Fig. 1A, F-J.

***Selected additional specimens*: Queensland.** North Kennedy District: NW of Pentland near "Lowholm", Jul 1954, *Blake* 19372 (BRI); Forty Mile Scrub, S of Mt Garnet, 18°07'S, 144°49'E, Jan 1992, *Forster* PIF9642 (A, B, BRI, DNA, K, L, MEL, QRS); Barrabas Scrub, 20°05'S, 146°55'E, May 1972, *Stocker* 863 (BRI, QRS). Leichhardt District: Melaleuca Creek Scrub, "Rookwood", 23°12'S, 149°46'E, Apr 1991, *Forster* PIF7927 & *McDonald* (BRI, MEL, QRS); 3 km S of Cracow Station Homestead, 25°24'S, 150°18'E, Jul 1990, *Forster* PIF7063 (BRI, MEL, QRS); Mt Zamia E.P., Springsure, 23°33'S, 148°05'E, Mar 1990, *Melzer* 6 (BRI). Burnett District: Along Barambah Creek, Mar 1952, *Blake* 18821 (BRI); Coalstoun Lakes N.P., 25°35'S, 151°54'E, Mar 1991, *Forster* PIF7827 (BRI, MEL, QRS). Wide Bay District: 10 km NNE of Booyal, Cordalba S.F. 832, Jan 1988, *Forster* PIF3340 *et al.* (BRI); Utopia, 14 km SSE of Biggenden, 25°38'S, 152°06'E, Dec 1991, *Forster* PIF9217 (BRI, K, L, MEL, QRS); Dundowran, Jul 1928, *Tyron* [AQ201707] (BRI); Mary Creek, c. 20 km S of Glastonbury, 26°22'S, 152°22'E, Apr 1978, *Sharpe* 2337 (BRI). Darling Downs District: "Browns Scrub", Meringandan, 27°26'S, 151°55'E, May 1985, *McKenzie* [AQ398285] (BRI). Moreton District: NW slopes of Mt French, 28°00'S, 152°37'E, Jul 1983, *Bird & Williams* [AQ399327] (BRI); Mt Russel, 16 miles [26.7 km] SW of Oakey, Apr 1963, *Hockings* 3 (BRI); Kalbar, Jan 1936, *Smith* [AQ201690] (BRI); Pine Mt, 12 km N of Ipswich, 27°32'S, 152°45'E, Jun 1978, *Williams* 78101 (BRI); Splityard Creek dam, 27°21'S, 152°40'E, Dec 1983, *Williams* 83084 (BRI, NSW).

***Distribution and habitat*:** *B. leichhardtii* is endemic to Australia and occurs in central and southern Queensland in coastal and subcoastal areas (Map 2). Plants grow in vineforests and vinethickets on a variety of soil types usually of volcanic or alluvial origins. The statement by Stanley (1983) that the species grows in open woodland is incorrect.

***Phenology*:** Flowering has been recorded between October to February. Fruiting has been recorded between January and August.

***Typification*:** The type collection (perhaps the first herbarium collection) of *B. leichhardtii* was collected by Ludwig Leichhardt in his traverse of the Moreton Bay area in 1844. Annotations on the sheet state that the specimen was collected at "Camerons Scrub" which is thought to be near Fassifern in the Lockyer Valley west of Brisbane (R.J.F. Henderson, pers. comm. 1998). The name *B. leichhardtii* (as `B. leichardi') was first proposed by Baillon (1858) but as a nomen nudum, and was subsequently validated by J. Mueller (1866). Publication of J. Mueller's account predates that of Baillon (1866) where the name *Amanoa faginea* Baill. is validly published (Henderson 1992).

Gehrmann (1908) described *B. melanthesoides* var. *australiensis* Gehrm. but did not explicitly mention a type. The name was reduced without comment to the synonymy of *B. leichhardtii* by Jablonsky (1915), although he did cite a representative specimen at B under the account of *B. leichhardtii* (cited as 'J.M. Bailey' from 'Brisbane'). It is possible that this is the specimen upon which Gerhmann based his name, but without location and examination of the actual sheet (now probably destroyed) resolution of the precise status of the name is not possible. At BRI there is a 'F.M. Bailey' specimen from 'Main Range' [AQ201715] and this may be a duplicate of the collection once at B. The Bailey specimen is *B. leichhardtii*.

***Notes*:** There is considerable phenotypic variation in leaf size and shape in different populations of *B. leichhardtii*. Juvenile or

shaded foliage is often oblanceolate in shape and approaches both the leaf size and shape commonly encountered in *B. exaltata.* Exposed foliage, particularly that from subcoastal vinethicket populations, is extremely microphyll in size and may be almost orbicular in shape.

***Uses*:** The species rarely grows large enough to produce millable timber but its wood may have potential for cabinet making and turnery as it is reputed to be easily worked (Bailey 1888, 1902). The foliage contains a prussic acid yielding glycoside ("glucoside") that is poisonous to cattle (Francis 1981).

***Conservation status*:** Widespread and not rare or threatened. Present in at least 15 conservation reserves in Queensland (Forster et al. 1991).

4. Bridelia tomentosa Blume, Bidjr. 597 (1826); *Amanoa tomentosa* (Blume) Baill., Adansonia 6: 336 (1866). **Type:** Java, *Blume s.n.* (lecto: L n.v. [photo at BRI]; iso: BM, BR, NY (all n.v.), fide Dressler 1996c: 298).

Bridelia tomentosa var. *glabrescens* Benth., Hook. J. Bot. 6: 8 (1854). **Type:** Hongkong, East Point, Hedges, *Champion* s.n. (holo: n.v.).

Bridelia glabrifolia Merr., Enum. Philipp. Flow. Pl. 2: 422 (1923); *B. tomentosa* var. *glabrifolia* (Merr.) Airy Shaw, nom. illeg., Kew Bull. 31: 383 (1976); *B. tomentosa* var. *lancifolia* Muell.Arg. in DC., Prodr. 15(2): 502 (1866) as "lanceaefolia", non *B. lancifolia* Roxb. **Type:** Philippines. Manila, *Gaudichaud* (holo: G n.v. [photo at BRI]).

Bridelia tomentosa var. *trichadenia* Muell.Arg. in DC., Prodr. 15(2): 501 (1866). **synon. nov. Type:** Northern Territory. Arnhemsland, *F. Mueller* s.n. (holo: G-DC n.v. [fiche at BRI].

Bridelia tomentosa var. *ovoidea* Benth., Fl. Austral. 6:120 (1873). **Type:** Northern Territory. Wood Island, *Gulliver* s.n. (holo: K n.v. [photo at BRI]; iso: MEL [515966, 515967]).

Bridelia phyllanthoides W.Fitz., J. Proc. Roy. Soc. W. Aust. 3: 163 (1918). **Type**: Western Australia, base of Mt Broome, 1905, *W.V. Fitzgerald* 823 (holo: NSW).

Bridelia tomentosa var. *eriantha* Airy Shaw, Kew Bull. 31: 384 (1976). **synon. nov. Type:** Northern Territory. c. 6 miles [10 km] N of Pine Creek township, 6 March 1965, *M. Lazarides* 145 & *L.G. Adams* (holo: K n.v.; iso: BRI, CANB, DNA, NSW).

[*Bridelia ovata* auct. non Decne.; Bentham (1873: 120)].

***Illustrations*:** Levitt (1981: Plate 18); Brock (1988: 102); Dunlop et al. (1995: 211).

Shrub to 4 m high. Stems without prop roots, not buttressed. Bark lightly fissured, cream. Indumentum ferruginous to straw-coloured, generally deciduous. Young stems with dense indumentum, soon glabrescent and lenticellate. Stipules linear to linear-lanceolate, 2–3.5 mm long, 0.3–1 mm wide, entire, with scattered to dense indumentum. Leaves petiolate; petioles 2.5–4 mm long, 0.5–1 mm wide, rounded adaxially, brownish, with sparse to dense indumentum; lamina elliptic, oblong, oblanceolate, obovate or orbicular, up to 90 mm long and 55 mm wide, with margins entire and sinuate, and with distinct marginal vein; venation comprising 9–11 lateral veins per side of midrib and reticulate interlaterals; tip acute, obtuse or rounded; base cuneate to rounded; upper surface matt green, with scattered indumentum or glabrescent, with lateral veins distinct and interlateral veins indistinct; lower surface glaucous pale blue-green, with scattered to dense indumentum mainly on veins or glabresent, lateral veins and midrib prominent and raised, and interlateral veins prominent. Inflorescence with numerous flowers in clusters; bracts lanceolate to triangular, 0.5–0.7 mm long, 0.4–0.5 mm wide, with scattered indumentum. Male flowers pedicellate; pedicels to 1.5 mm long, glabrous; sepals lanceolate-ovate, 0.8–1.6 mm long, 0.7–0.8 mm wide, glabrous; disc circular with a slightly undulating margin, 1–1.2 mm diameter; petals spathulate to obovate with the tip crenate, 0.5– 0.8 mm long, 0.4–0.5 mm wide;

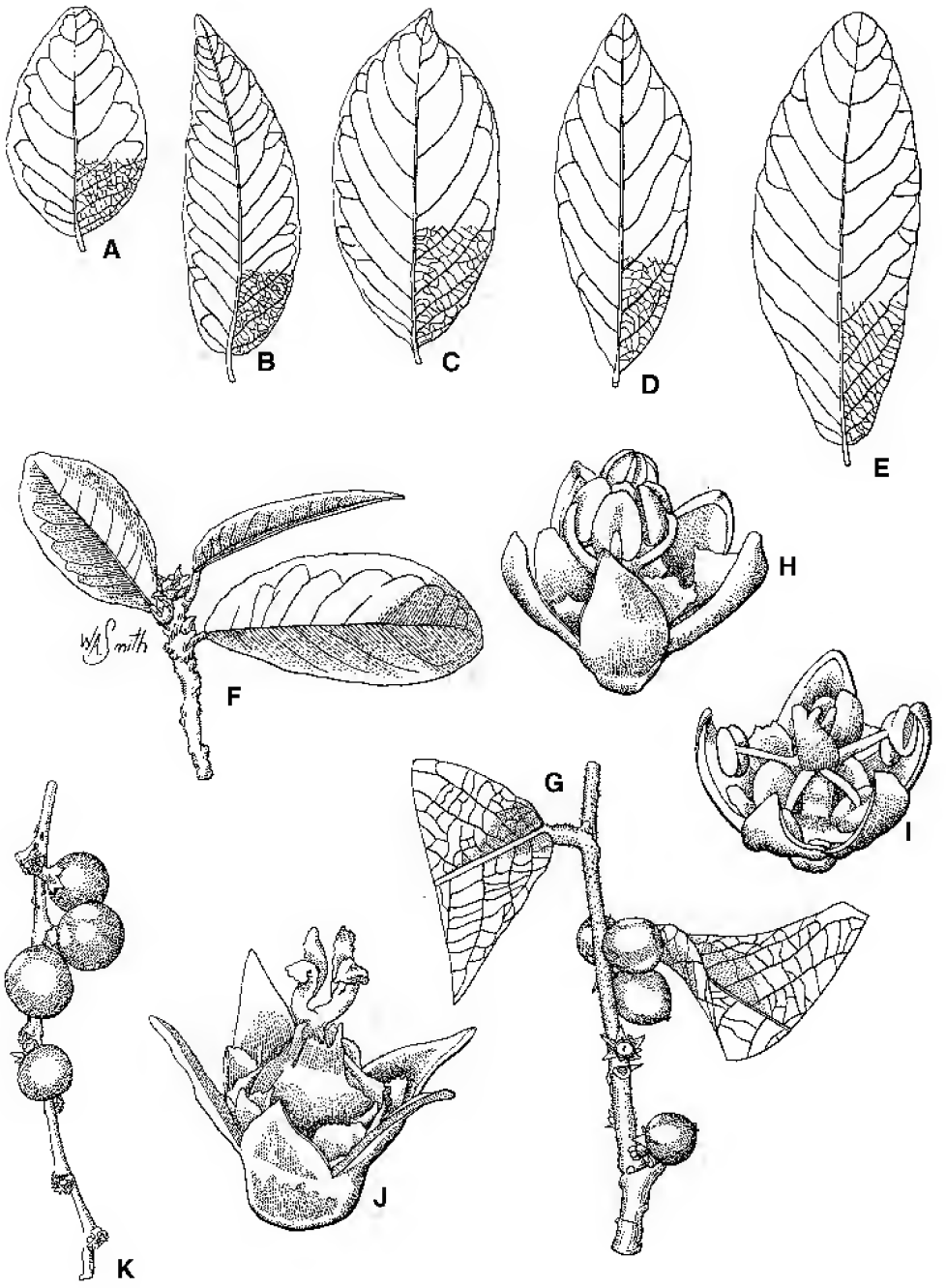

Fig. 1. *Bridelia.* A,F-J. *B. leichhardtii*, B. *B. exaltata*, C. *B. insulana*, D,K. *B. tomentosa*, E. *B. finalis*. A-E. undersurface of mature leaf showing lateral and interlateral venation. x 0.5. F. flowering twig. x. 1.5. G. fruiting twig. x. 1.5. H. male flower with stamens inflexed around pistillode. x 12. I. male flower with stamens reflexed and pistillode obvious. x 12. J. female flower. x 12. K. fruiting twig. x 1.5. A from *Forster* 14863 (BRI); B from *Bean* 8526 (BRI); C from *Hyland* 7801 (BRI); D from *Forster* 13555 (BRI); E from Fell DGF4251 (BRI); F & J from *Forster* 9642 (BRI); G from *Forster* 13297 (BRI); H & I from *Forster* 3304 (BRI); K from *Clarkson* 9643 (BRI). Del. W. Smith.

staminal column 0.4–0.5 mm long with filaments 0.2–0.5 mm long, anthers roughly ellipsoid, 0.3–0.5 mm long, 0.2–0.3 mm wide, pistillode 0.4–0.5 mm long, shortly bilobed. Female flowers pedicellate to 1.5 mm, sepals and petals same as for male flowers; inner disc irregularly lobed, lobes to 0.5 mm long; ovary ellipsoid, c. 0.8 mm long, 0.5–0.6 mm wide, glabrous; styles 2, 0.4–0.6 mm long, bifid. Fruits 1–10 cluster; 2-seeded, globose to ellipsoid, 3.5–5 mm long, 2–6 mm wide, slightly pedicellate, red-brown when immature, black when fully ripe. Fig. 1D,K.

***Selected additional specimens*: Western Australia.** Bougainville Peninsula, 2 km SW of August Pool, Vansittart Bay, 14°05'S, 126°11'E, May 1984, *Forbes* 2200 (CANB, MEL, PERTH); Lone Dingo between Mitchell Plateau Mining Camp & Port Warrender, 14°35'S, 125°43'E, May 1981, *Tracey* 15024 (BRI); Walsh Point-Port Warrender, 14°34'S, 125°45'E, May 1981, *Tracey* 15185 (BRI). **Northern Territory.** Douglas Hot Springs, 13°45'S, 131°27'E, Feb 1989, *Clark* 1705 (BRI, DNA); Nhulunbuy, Gove Peninsula, 12°10'S, 136°52'E, Apr 1982, *Hinz* 155 (BRI, DNA); Wunya Beach, Aurari Bay, Arnhem Land, 11°43'S, 133°13'E, Jun 1988, *Munir* 6160 (AD, BRI); Little Lagoon, Groote Eylandt, May 1948, *Specht* 400 (BRI, PERTH); Bauhinia Downs Station, Alligator Stockyard waterholes, 16°04'S, 135°23'E, May 1985, *Wightman* 1843 & *Leach* (BRI, CANB, DNA). **Queensland.** Cook District: South Island, near Lizard Island, 14°42'S, 145°28'E, Jul 1990, *Batianoff* 12196 & *Hegerl* (BRI); Lockerbie, 10 miles WSW of Somerset, Apr 1948, *Brass* 18485 (BRI); 5 km WSW of Bertiehaugh Homestead, 12°12'S, 142°28'E, Jul 1988, *Dalliston* CC181 (BRI); c. 3.5 km WSW of Lamond Hill, middle of Claudie River, 12°43'S, 143°46'E, Apr 1990, *Fell* 2054 (BRI, QRS); Peach Creek, 19 km along road to Leo Creek mine, McIlwraith Range, 13°42'S, 143°13'E, Jun 1992, *Forster* PIF10066 *et al.* (BRI, QRS); Garraway Creek Crossing, Iron Range road, 12°43'S, 143°09'E, Jul 1993, *Forster* PIF13555 & *Tucker* (BRI, K, MEL, QRS); Robber Tree Scrub, Iron Range area, 12°44'S, 143°15'E, Jun 1994, *Forster* PIF15398 (BRI, QRS); Foot of Byerstown Range, 16°00'S, 144°50'E, Mar 1975, *Hyland* 8137 (BRI, QRS); between Weipa turnoff on Telegraph Line & York Downs, Apr 1980, *Morton* 726 (BRI). North Kennedy District: Elliot Toe, Bowling Green Bay N.P., 9 km NNE of Woodstock, 19°31'S, 146°52'E, May 1991, *Forster* PIF8353 & *Bean* (BRI, K, MEL, QRS); Bennett Road, Strathdickie, Feb 1988, *Perry* [AQ437033] (BRI).

***Distribution and habitat*:** *B. tomentosa* is widespread in northern Australia in Western Australia, the Northern Territory and Queensland (Map 1). The species is also widespread in Asia, Malesia and Indochina (Dressler 1996c). In Australia, *B. tomentosa* grows in open woodland and in, or along the margins of, deciduous vinethickets, on a variety of substrates.

***Phenology*:** Flowers have been recorded from February to May and fruits from May to August.

***Typification*:** *B. tomentosa* (as *B. tomentosa* var. *trichadenia* Muell.Arg.) was first recorded for Australia by J. Mueller (1866) based on material collected by F. Mueller in the Northern Territory. Bentham (1873) referred to material of this species as both *B. tomentosa* and *B. ovata*, this latter name being a misapplication to the Australian material.

Dressler (1996c) stated that Airy Shaw lectotypified the name *B. tomentosa* with a Blume collection at BO and that other specimens of apparently the same collection at BM, BR, L and NY are isolectotypes. Airy Shaw (1980) stated "Type: Java, `in montanis Bantam et Buitenzorg', *Blume* (BO)". This is probably wishful thinking on Airy Shaw's part as, according to A. Kostermans (pers. comm. 1992) he never visited that institution nor obtained material on loan from it. Despite this, he often indicated specimens as being present at BO without definite evidence (cf. Forster 1997). There are many collections of Blume's at BO with the majority not in type folders and often difficult to locate (Forster 1994; Forster & Liddle 1994). I could not locate the Blume collection of *B. tomentosa* at BO in 1992; however, this should not be construed as definite evidence that it does not exist. Regardless of its existence or otherwise, I believe that Airy Shaw did not lectotypify the name in 1980, rather he was indicating where he thought the collection might be. If this is the case then the three sheets of this collection at L (L903155-234, L903155-231 and L903155-238) should be regarded as lectotype of the name, and the remaining sheets at other herbaria as isolectotypes.

A similar situation is associated with typification of *B. glabrifolia* Merr. which is a renaming of *B. tomentosa* var. *lancifolia* Muell.Arg. (non *B. lancifolia* Roxb.). Dressler (1996c) once again copied Airy Shaw (1980b)

and stated that the type, *Gaudichaud* s.n., is in G-DC and that lectotypification was undertaken by Airy Shaw. This specimen is not in G-DC but was located by L.W. Jessup in the undetermined Euphorbiaceae holdings in G in 1994.

Notes*: *B. tomentosa is a variable species in Australia, mainly with regard to leaf shape and indumentum density. Airy Shaw (1980b) recognised four varieties for the Australian material of this species, although he did not provide a key to distinguish them. Dressler (1996c) recognised two varieties of this species, based on leaf indumentum density.

What may seem to be distinct variants to the herbarium-based worker are often demonstrated to be merely extremes or examples of phenotypic expression. Examination of many populations of *B. tomentosa* revealed that indumentum density (and also leaf shape) is quite variable depending on leaf age, shading and substrate. Plants from localities that have high insolation and severe seasonal water deficit stress tend to have small leaves with denser indumentum. Good examples of this may be seen in the populations of *B. tomentosa* from the limestone karsts near Chillagoe in Queensland. All of these plants have quite a dense indumentum. As with other taxa at Chillagoe, this indumentum is often lost or is not as dense when the plant is grown elsewhere (cf. Forster 1995). Hence, leaf indumentum density in *B. tomentosa* appears to vary continuously and is therefore, no basis whereupon varieties can be formally recognised.

Uses: The fruit of *B. tomentosa* are eaten by aboriginal people in the Northern Territory and known by various local names (Brock 1988; Levitt 1981; Russell-Smith 1985).

***Conservation status*:** Common and widespread.

Acknowledgements

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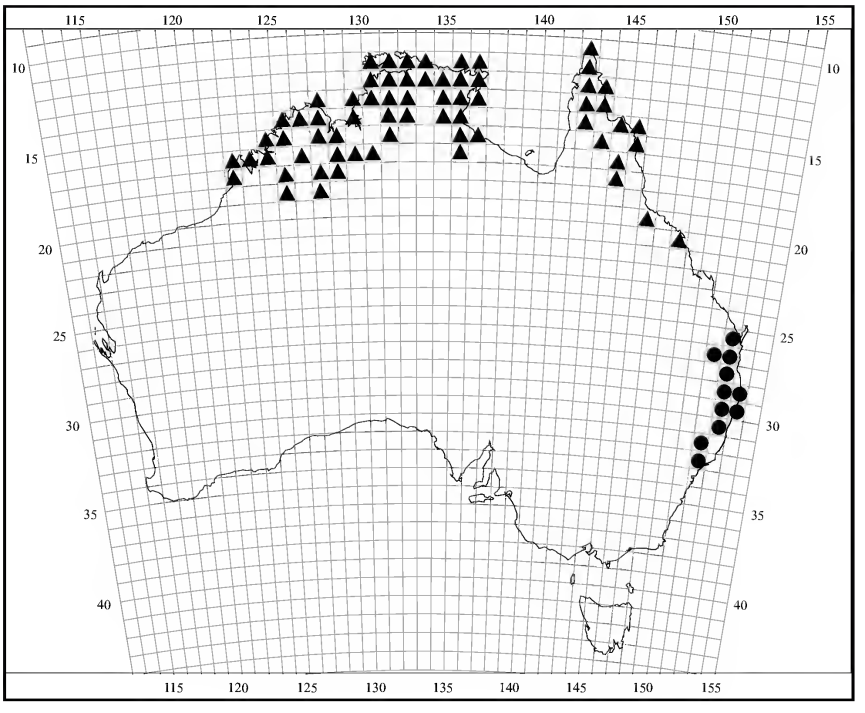
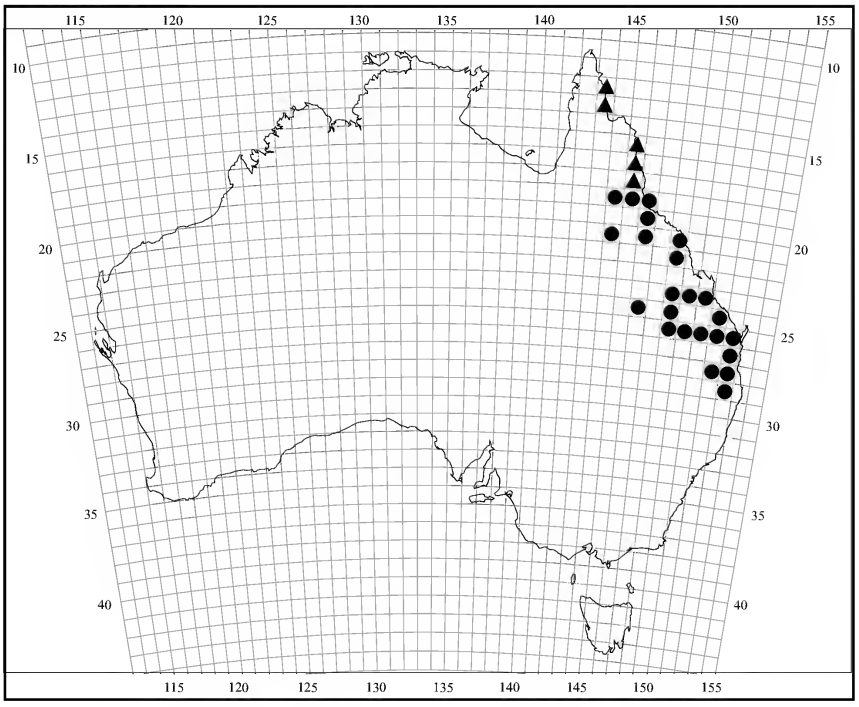
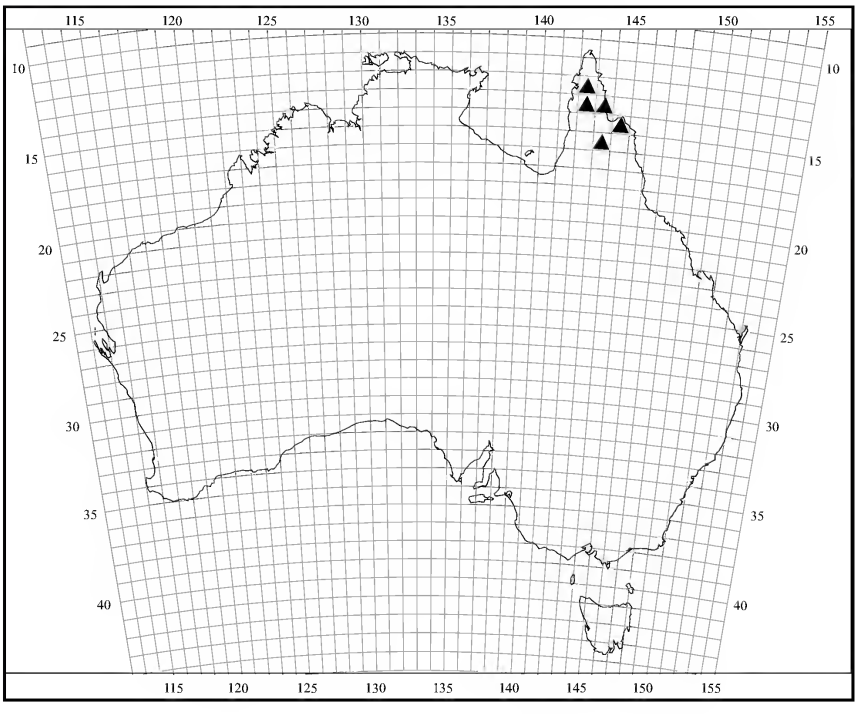


Map 1. Distribution of ●*Bridelia exaltata* and ▲*B. tomentosa*.



Map 2. Distribution of ●*Bridelia insulana* and ▲*B. leichhardtii*.



Map 3. Distribution of ▲*Bridelia finalis*.

Rhodamnia angustifolia (Myrtaceae), a new and endangered species from south-eastern Queensland

Neil Snowand Gordon P. Guymer

Summary

Snow, Neil & Guymer, Gordon P. (1999). *Austrobaileya* 5(3): 421-426. The new species *Rhodamnia angustifolia* N. Snow & Guymer (Myrtaceae) is described from the Cedar Creek area of the Wietalaba State Forest (583) south of Gladstone and Calliope in south-eastern Queensland. It is easily distinguished from other species of *Rhodamnia* by its narrowly elliptic leaves. The species is known from only nineteen individuals on a single ridgetop and subtending slopes in SF 583. Its recommended conservation status is Endangered under both the *Queensland Nature Conservation Act 1992* and the IUCN Species Survival Commission. The essential oils previously found in the species are discussed briefly.

Keywords: *Rhodamnia angustifolia*, Myrtaceae, Queensland, Australia, conservation, systematics, essential oils.

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Introduction

The genus *Rhodamnia* Jack comprises some thirty arborescent species and ranges from southern China and the Malay peninsula to New Caledonia, and in Australia from eastern Queensland to northern New South Wales (Scott 1979; Guymer & Jessup 1986; Guymer 1988). *Rhodamnia* is represented in Australia by eleven described species and apparently three undescribed species from Cape York Peninsula, Queensland (Guymer in Henderson 1997). In this paper we describe the new species *Rhodamnia angustifolia* N.Snow & Guymer, which is known only from a single ridgetop and subtending slopes in the Wietalaba State Forest (SF 583), about 45 km S of Gladstone in the Port Curtis pastoral district of Queensland (Halford 1998; cited as *Rhodamnia* sp. (Calliope N. Gibson 1335) by Guymer in Henderson 1997: 135).

Materials and Methods

Descriptions are based on herbarium material and from pickled material collected in the field. The list of characters studied follows closely that of Snow & Guymer (1999). Floral measurements are based on material from the individual tree from which the type specimen was collected, currently the only known flowering specimen. Measurements of the fruit are mostly from the specimen of *J. Brushe* 1186 & *L. Brushe*, also collected from the tree from which the type was collected. In November of 1997, D. Halford and the first author spent four days at Wietalaba State Forest surveying the only known population of *R. angustifolia*. Because of the rarity of the species, all known specimens, including sterile material are cited here (see Snow & Keating 1999).

Rhodamnia angustifolia N.Snow & Guymer, **sp. nov.** speciebus aliis generis foliis angustis (3–15 mm latis) differt. **Typus:** Australia. Queensland. Port Curtis District: Wietalaba State Forest, c. 31 km S of Calliope, 24°17'09"S, 151°12'53"E, Australian metric grid reference: 9149 Calliope 188129, 20 Nov 1997, *D. Halford & N. Snow* Q3450 (holo: BRI [1 sheet and spirit]; iso: AD, B, BRI, CANB, DNA, GREE, HO,JEPS, K, L, MEL, MEXU, MO, NSW, NE, NY, SING, TEX, UPS, US). (All type duplicates from a single genotype.)

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Single- or multi-stemmed erect trees, 4–10 m tall. Bark of main trunk smooth but furrowed and somewhat flaking in small angular patches, greyish. Branches of current year's growth rounded, brownish, smooth, sparsely short sericeous but becoming glabrous; oil glands absent. Stipules of two to several very short (and obscure) ferrugineous setose hairs. Leaves opposite, decussate, discolourous, coriaceous, trinerved, mostly narrowly elliptic but occasionally narrowly obovate or falcate, 20–70(–85) mm long, (3–)5–12(–15) mm wide, cuneate at base, obtuse to acute at apex, margins flat; adaxial surface sparsely sericeous becoming glabrous, oil glands scattered to dense but usually invisible to naked eye, midvein impressed; abaxial surface very shortly and densely tomentose, lateral, tertiary and intramarginal veins usually prominent. Petioles 2.5–4.0 mm long, channelled, eglandular. Inflorescence a cluster of 2–7 flowers on short shoots less than 1 mm long in axils of leaves or leaf scars; peduncles rigid, up to 1.5 mm long, shortly sericeous. Bracteoles two, narrowly ovate, not foliaceous, c. 0.5 mm long by 0.3 mm wide, rigid, not exceeding base of sepal lobes, sericeous, caducous in fruit. Hypanthium obconic to urceloate, the tube not extending beyond ovary apex, oil glands sparse to common and visible with magnification, sparsely short sericeous. Sepals 4, distinct in bud, lobes free, 0.3–0.5 mm long, broadly ovate, apex rounded to obtuse, sparsely short sericeous above and below, persistent in fruit, mostly ascending above body of fruit. Petals four, alternate with sepals, yellowish-white, c. 2.5 mm long by 3.0 mm wide, broadly ovate to oblate, apex rounded, glabrous above but margins somewhat ciliate, glabrous below, oil glands sparse but visible with magnification. Stamens 65–75, multiseriate, excluded, folded centrewards in bud; filaments 2–4 mm long, staminal disk glabrous; anthers globose, dorsifixed near base, versatile, 0.5–0.8 mm long, dehiscing via longitudinal slits, with a single apical gland. Ovary 1-locular 1 with 2 parietal placentas; ovules 18–21 and attached irregularly. Style 1, 4.5–5.0 mm long, mostly straight, glabrous, narrowly if at all capitate. Fruit a berry, subglobose to globose, rounded at base, 3–5 mm long by 4–6 mm wide, glabrous or glabrescent, yellowish orange with some red when fresh but increasingly red upon drying. Seeds 1 or 2(–4), globose to suborbicular to somewhat reniform, smooth, light brown; testa hard and somewhat bony; adjacent seeds not fused. Embryo slightly curved to C-shaped, lacking oil glands; hypocotyl longer than cotyledons, about same diameter as cotyledonary pair, barely swollen near radicle, the tip at same horizontal (= transverse) plane as cotyledons; cotyledons relatively thin (see Landrum and Stevenson 1986), not folded back towards hypocotyl.

***Additional specimens examined*: Queensland.** Port Curtis District: Wietalaba State Forest, adjacent to the road on ridgetop, Jan 1998 [fruit], *J. Brushe* 1186 *& L. Brushe* (BRI, MEL);Wietalaba SF, c. 31 km S of Calliope, 24°17'05"S, 151°12'49"E, Nov 1997 [bud], *D. Halford & N. Snow* Q3456 (BRI); State Forest 583, Wietalaba, 32 km S of Calliope, 24°17'S, 151°12'E, Nov 1993 [sterile], *N. Gibson* 1334 (BRI) and 1335 (BRI); State Forest 583, Wietalaba, 32 km S of Calliope, 24°17'S, 151°12'E, Apr 1994 [sterile], *N. Gibson* 1336 (BRI); State Forest 583, Wietalaba, 24°18'S, 151°16'E, May 1993 [sterile], *Gibson* s.n. (BRI AQ 568108); State Forest 583 Wietalaba, 24°17'02"S, 151°12'53"E, Dec 1995 [sterile], *P.I. Forster* PIF18272 *et al.* (BRI, NSW, MEL, QRS); Near headwaters of Cedar Ck, State Forest 583, 24°17'15"S, 151°13'13"E, Jul 1995 [sterile], *E.J. Thompson* CAL355 *& G.P. Turpin* (BRI); Wietalaba SF, c. 31 km S of Calliope, 24°17'12"S, 151°12'51"E, Nov 1997 [sterile], *D. Halford et al.* Q3449 (BRI); Wietalaba SF, c. 31 km S of Calliope, 24°17'18"S, 151°12'44"E, Nov 1997 [sterile], *D. Halford et al.* Q3446 (BRI); Wietalaba SF, c. 31 km S of Calliope, 24°17'36"S, 151°13'05"E, Nov 1997 [sterile], *D. Halford & N. Snow* Q3452 (BRI).

***Distribution*:** *Rhodamnia angustifolia* occurs at the head of Cedar Creek along a single ridgetop and subtending slopes in the Wietalaba State Forest (SF 583), c. 45 km south of Gladstone and c. 30 km S of Calliope.

***Habitat*:** The species grows in full sun or in a closed canopy of microphyll vineforest with *Choricarpa subargentea* (C.T.White) L.A.S.Johnson, *Barklya syringifolia* F.Muell., *Archidendropsis thozetiana* (F.Muell.) I.C.Nielsen, *Backhousia kingii* Guymer, *Sterculia quadrifida* R.Br., and *Araucaria cunninghamii* Aiton ex D. Don as the dominant tree species. The substrate is reddish or brown loam from mudstones of Muncon volcanics. The elevation range is approximately 200 to 600 metres.

***Flowering period*:** Flowering material is known only from the type specimen, collected in November, but given the apparently good condition of abundant young bud material on *Halford & Snow* Q3456, flowering almost certainly extends into December.

***Fruiting period*:** Confirmed only for January by a single specimen, *Brushe* 1186 & *Brushe*, but likely to begin as early as late November or early December.

***Essential oils*:** Brophy et al. (1997) have studied profiles of essential oils in *Rhodamnia*. These authors (op. cit.) report that within the genus, at nearly 1% of total mass, *R. angustifolia* has one of the highest oil yields. Both mono- and sesquiterpenes are produced, and oils showing significant levels include the monoterpenes α-pinene, α-thujene, myrcene, limonene, β-phellandrene, *p*-cymene, and termpinen-4-ol. The principal sesquiterpenes include β-caryophyllene, humulene, caryophyllene oxide, globulol, and spathulenol. Five unnamed oxygenated sesquiterpenes with the general formula $C_{15}H_{24}O$ were present in amounts ranging from 0.2-16%. Sesquiterpenes of this general formula are also found in *Rhodamnia maideniana* C.T.White, which occurs from the Moreton District in Queensland southward to New South Wales (Henderson 1997).

***Notes*:** With its shortly and densely tomentose ("hoary") lower leaf surfaces and sparse to dense oil glands in the leaves, *Rhodamnia angustifolia* shows affinities with *R. dumicola* Guymer & Jessup, *R. whiteana* Guymer & Jessup, and *R. costata* A.J. Scott (as amended by Guymer & Jessup 1986), and it will key with these species in Guymer and Jessup (1986). However, its narrowly elliptic leaves immediately distinguish it from these species. Its closest relative may be *R. dumicola,* given similar features of the leaves and bark, the fascicled flowers occurring on very short shoots, and the relatively high number of ovules. Its leaf glands, however, generally can be seen only in bright transmitted light.

The tree from which the holotype specimen of *Rhodamnia angustifolia* was collected was growing on an open, disturbed ridgetop, but most individuals were found on adjacent lower midslopes with a southwest or easterly aspect (Halford 1998). We found individuals occurring singly or in groups of three to six plants.

Several plants had suckers at or near the base, and regrowth was occurring from the base of one small, apparently dead tree trunk (*Halford* et al. Q3446). One specimen (*D. Halford & N. Snow* Q3456) growing near the edge of the forest at the ridgetop had a very dense crown, but the foliage on other specimens was more open. The juvenile foliage (*Halford & Snow* Q3446) has somewhat longer leaves.

Embryos were absent in most of the ten mature fruits examined. The larvae of an undetermined insect (c. 2 mm long) was seen enveloped completely within an undamaged and apparently mature seed, suggesting the insect was present before the outer testal layer of the seed solidified during ontogeny. An obvious question that could be examined in conservation studies is whether insect predation on the fruit, seed, or embryo is preventing successful sexual reproduction of *Rhodamnia angustifolia.*

The abundant flowers on the "type" tree at the time of collection in November had a faint but sweet fragrance. Bees, presumably the Italian honeybee *Apis mellifera*, were observed pollinating flowers at that time.

***Etymology*:** The specific epithet *angustifolia*, Latin for narrow and leaf, refers to the narrow leaves, which are the narrowest of all Australian species of *Rhodamnia.*

***Conservation status*:** The extensive fieldwork of D. Halford, N. Snow, P. Forster, and W. McDonald has revealed *Rhodamnia angustifolia* growing in only one general area of approximately 60 hectares (Halford 1998). A total of 19 plants are known in the wild. Seedling recruitment was not observed by Halford and Snow, although three saplings of approximately two metres height were noted by McDonald (pers. comm.). Portions of the area recently have been burned and are heavily infested with *Lantana camara* L., one of the

most invasive and potentially threatening weeds of native vegetation in Queensland (Fensham et al. 1994). The recommended conservation status for *Rhodamnia angustifolia* is Endangered, as defined by both the *Queensland Nature Conservation Act 1992* and the IUCN Species Survival Commission (1994). Other areas worthy of detailed searches for this species are the vineforest communities in the Kalpower area and the western slopes of KroombitTops (Halford, 1998).

Preserved material for genetic studies.

Adequate leaf material of *R. angustifolia* is available from all known collections for the purposes of DNA extraction. Each collection number of *Halford & Snow* or *Halford* et al. cited herein represents a separate genotype (Snow 1997, Appendix A). A molecular survey of *Rhodamnia angustifolia*, such as that undertaken for some species of *Austromyrtus* (e.g., Shapcott and Playford 1996), would help to assess genetic diversity of this endangered species.

Acknowledgments

We thank D. Halford for considerable assistance in the field and reviewing the manuscript, J. Brushe for assistance in the field and making a separate trip to collect mature fruit, W. Smith for the illustrations, B. Simon for the Latin diagnosis, and A. Lyne for his review of the manuscript. This work was supported by grants from the Australian Biological Resources Study during 1997-1999.

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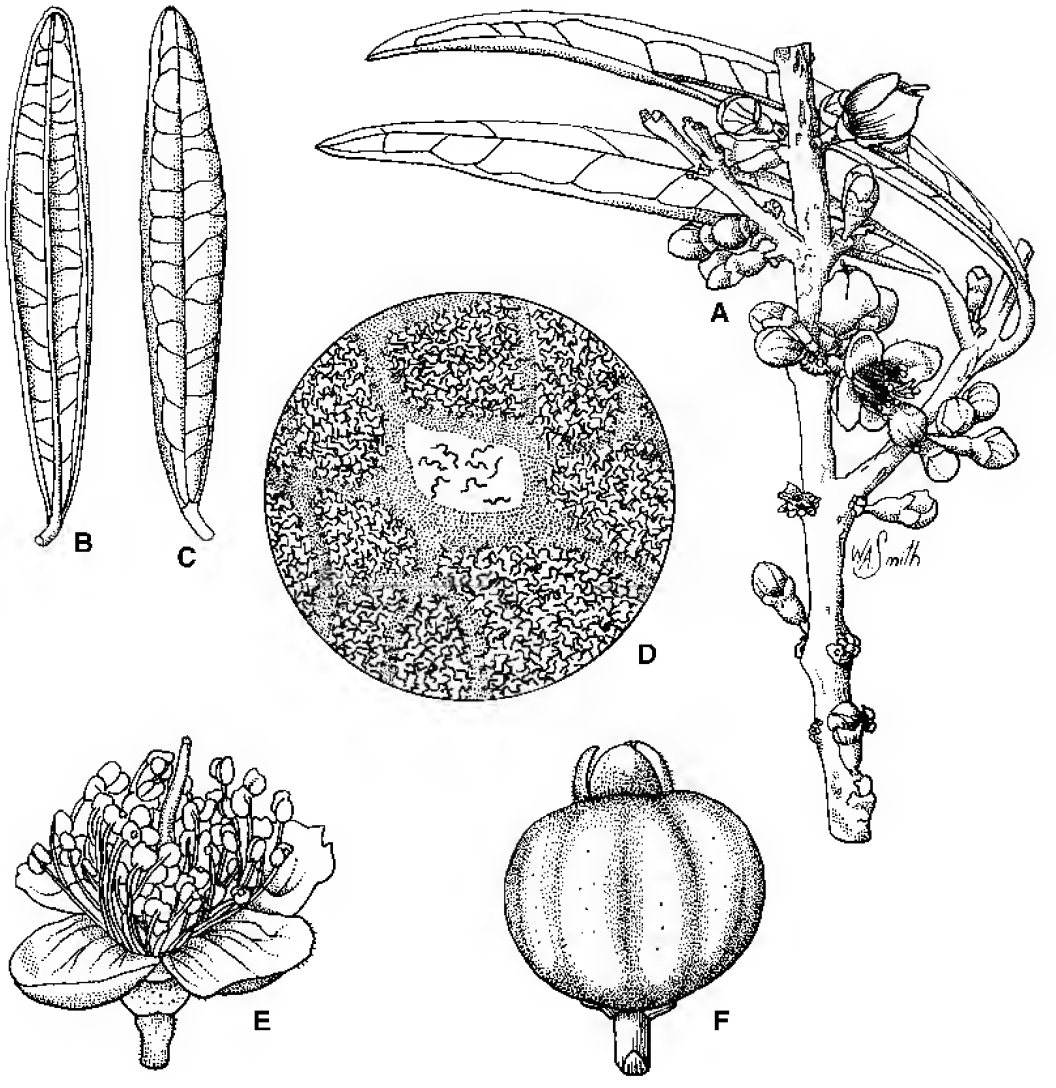

Fig. 1. Details from holotype of ***Rhodamnia angustifolia*** A. Portion of flowering branch x 2. B. Abaxial view of leaf x 2. C. Adaxial view of leaf x 2. D. Detail of abaxial leaf surface showing dense covering of short, white, tomentose hairs x 50. E. Flower x 6. F. Fruit x 6. All drawn from *Halford* & *Snow* Q3450.

Fig. 2. Main trunk of ***Rhodamnia angustifolia*** at breast height (*Halford* & *Snow* Q3456) showing smooth, slightly fisssured, grey bark (Photo N. Snow).

A revision of *Stylidium* sect. *Debilia* Mildbr., *S.* sect. *Floodia* Mildbr. and *S.* sect. *Lanata* A.R.Bean (Stylidiaceae)

A.R. Bean

Summary

Bean, A.R. (1999). A revision of *Stylidium* sect. *Debilia* Mildbr., *S.* sect. *Floodia* Mildbr. and *S.* sect. *Lanata* A.R.Bean (Stylidiaceae). *Austrobaileya* 5(3): 427-455. Three taxonomic sections of *Stylidium* are enumerated (*S.* sect. *Debilia, S.* sect. *Floodia* and *S.* sect. *Lanatae* sect. nov.) comprising 25 species (including *S. austrocapense, S. delicatum, S. foveolatum, S. velleioides* spp. nov. and *S. paniculatum* comb. nov.) indigenous to northern and eastern Australia (Kimberley region of Western Australia, Northern Territory, Queensland and northern New South Wales). The new species are illustrated, while for all species, distribution maps and notes on habitat, conservation status and taxonomic affinities are provided.

Keywords: *Stylidium, Stylidium* sect. *Floodia, Stylidium* sect. *Debilia, Stylidium* sect. *Lanata*, taxonomy, keys, Australian flora, Stylidiaceae.

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Introduction

The genus *Stylidium* Willd. is largely restricted to Australia, and reaches its greatest species diversity in south-western Western Australia. Comprehensive accounts of the genus have been provided by Brown (1810), de Candolle (1839), Bentham (1868), Mildbraed (1908) and Erickson (1958).

Three related sections are treated in this paper: *S.* sect. *Floodia* was established by Mildbraed (1908) with the single species, *S. floodii* F.Muell. In recent years, several species related to *S. floodii* have been described, notably by Lowrie and Kenneally (1997). Most of the constituent species are confined to tropical Australia, with *S. desertorum* Carlquist occuring in semi-arid areas.

S. sect. *Debilia* is typified by *S. debile* F.Muell., and it comprises several species indigenous to northern, central and eastern Australia, as far south as Sydney.

S. eriorhizum R.Br. was included in *S.* sect. *Debilia* by Mildbraed (loc. cit.). It and two other species described by Bean (1999) are here placed into a new section (*S.* sect. *Lanata*) on the basis of the thickened woolly plant bases, perennial habit, indeterminate central rachis and large spherical seeds with a small nipple.

All of the species presented here belong in *S.* subg. *Tolypangium* (Endl.) Mildbr. Three members of this subgenus occurring in northern Australia do not belong to any of the sections treated here. *S. graminifolium* Sw. belongs in *S.* sect. *Stylidium*, while *S. eglandulosum* F. Muell. and *S. laricifolium* A. Rich. belong in *S.* sect. *Sparsifolia* Benth. No species belonging to *S.* section *Tolypangium* occur in northern and eastern Australia.

Terminology

The flowers of all *Stylidium* species are gamopetalous, as they possess a corolla tube, albeit usually rather short and inconspicuous. However, the corolla lobes (called petals in this paper) are here treated as being "free" if they are not united beyond the top (or "throat") of the corolla tube. This interpretation is in line with Erickson (1958) and avoids confusion when referring to the apical ornamentation of the corolla parts, which would otherwise be known as lobes of the corolla lobes.

Because the pattern of petal fusion is very valuable in diagnosing *Stylidium* species,

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a special terminology is used here. A1 and A2 refer to the anterior petals (on either side of the labellum); P1 and P2 refer to the posterior petals, with A1 being adjacent to P1. The '+' operator indicates that the petals indicated are free (sensu Erickson), while a '/' operator indicates that the petals indicated are fused e.g. A1 + A2 + (P1/P2) means that the anterior petals are free from the posterior petals and from each other, but that the posterior petals are fused to each other.

The term paracorolla, used here, was introduced by Slooten (1954), and refers to small lobes or flanges of tissue attached to the corolla at the throat. This term is roughly equivalent to the commonly used term "throat appendages", but is more comprehensive, as it covers situations where there is a continuous raised ring of tissue.

Materials and methods

This revision was based on the examination of herbarium specimens, spirit material and reconstituted floral material from AD, BM, BRI, K, DNA, MBA, QRS, NSW and MEL, and was supplemented by field work by the author throughout Queensland. Floral measurements were based on material preserved in spirit, where it was available, or on herbarium material reconstituted by boiling in water. Details of the collections used for these measurements are given in each species treatment. Leaves, stems, scapes, capsules and seeds were measured from dried material.

Morphological data for all taxa have been recorded as a DELTA data set (Dallwitz et al. 1993), and species descriptions have been generated by DELTA from these data.

Dimensions of various plant parts are given as *circa* only when there was difficulty in providing accurate measurements e.g. petiole length for some species, or when less than 4 measurements were possible for the character, because of lack of available material.

Distribution maps are provided for all species. A symbol indicates a herbarium record for the taxon within that 1° x 1° square. Solid (or filled) symbols indicate that there is at least one recent collection (1960-present). Outline (or unfilled) symbols indicate that the most recent collection for that 1° x 1° square was before 1960. Latitude and longitude data from Lowrie and Kenneally (1997) have been added to the maps for *S. leptorrhizum* (syn. *S. barrettorum*) and *S. adenophorum*, and from Kenneally and Lowrie (1994) for *S. costulatum*.

Taxonomy

Key to the *Stylidium* subgenera occurring in northern and eastern Australia

1. Hypanthia and capsules linear, 8–20 times longer than wide 2
   Hypanthia and capsules globose to ellipsoidal, 1–4 times longer than wide 3

2. Petals laterally fused (A1/P1) + (A2/P2) ..... **S.** subg. **Alsinoides**
   Petals all free or posterior petals fused ..... **S.** subg. **Andersonia**

3. Hypanthia and capsules globose, 1–1.3 times longer than wide ..... **S.** subg. **Centridium**
   Hypanthia and capsules ellipsoidal to obconical, 1.4–4 times longer than wide ..... **S.** subg. **Tolypangium**

Stylidium subg. **Tolypangium** (Endl.) Mildbr., Pflanzenr. 35: 31 (1908); *S.* sect. *Tolypangium* Endl., Gen. Pl. 520 (1838). **Type:** not designated.

Key to the species of *Stylidium* sect. *Floodia*, *S.* sect. *Debilia* and *S.* sect. *Lanata*

1. Leaves linear, less than 1 mm wide (sect. *Floodia*) 2
   Leaves oblanceolate or spathulate, 2.4–10.7 mm wide 14

2. Inflorescences 1-flowered ..... **3. S. rubriscapum**
   Inflorescences many-flowered, cymose 3

3. Capsule conspicuously 5-angled 4
   Capsule smooth or ribbed, but not 5-angled 5

4. Leaf apex acute; 2 sepals fused except at apex; capsule c. 4.5 mm long ..... **10. S. costulatum**
   Leaves bluntly mucronate; sepals all free; capsule 2.5–3 mm long ..... **9. S. turbinatum**

5. Leaves with glandular hairs, leaf apex obtuse ..... **12. S. adenophorum**
   Leaves glabrous, leaf apex acute to mucronate 6

6. Hypanthium and sepals glabrous ..... **1. S. foveolatum**
   Hypanthium and sepals glandular-hairy 7

7. Flowers with 3 free sepals and 2 fused sepals 8
   Flowers with sepals all free 10

8. Leaves mostly in terminal rosette 9
   Leaves scattered along stems ..... **2. S. clarksonii**

9. Bracts glandular-hairy; anterior petals entire ..... **8. S. delicatum**
   Bracts glabrous; anterior petals bilobed ..... **7. S. symonii**

10. Scapes thick (1.0–2.3 mm in diameter); leaves (11–)16–75 mm long; labellum with basal appendages ..... **11. S. desertorum**
    Scapes thin (0.3–1.0 mm in diameter); leaves 10–35 mm long; labellum without basal appendages 11

11. Leaves with needle-like mucro ..... **5. S. mucronatum**
    Leaves acute to acuminate 12

12. Sepals ovate; anterior petals c. 3.5 mm long, bilobed ..... **4. S. rivulosum**
    Sepals deltate to lanceolate; anterior petals 0.9–2.6 mm long, entire 13

13. Leaves 10–25 mm long, glandular hairs 0.3–0.5 mm long; sepal apex acute to acuminate ..... **8. S. delicatum**
    Leaves 22–35 mm long, glandular hairs 0.15–0.2 mm long; sepal apex obtuse ..... **6. S. floodii**

14. Plants with conspicuous woolly rootstock; inflorescence with indeterminate central rachis; seeds spherical, 0.4–0.8 mm across, with a small nipple (sect. *Lanata*) 15
    Plants with unthickened rootstock; inflorescence cymose without central rachis, or racemose; seeds globose to ellipsoidal, 0.2–0.4(–0.5) mm long, without nipple (sect. *Debilia*) 17

15. Inflorescence branches and bracts glabrous; leaves (including petioles) 9–14 mm long ..... **24. S. ramosissimum**
    Inflorescence branches and bracts glandular-hairy; leaves (including petioles) 20–60(–100) mm long 16

16. Leaf margins hairy; bracts 1.5–2.5 mm long; sepals 1.0–1.7 mm long ..... **23. S. eriorhizum**
Leaf margins glabrous; bracts 3.5–6.5 mm long; sepals 2.4–2.8 mm long ..... **25. S. leiophyllum**

17. Leaves glandular-hairy ..... **13. S. semipartitum**
Leaves glabrous 18

18. Scapes with long simple hairs 19
Scapes glabrous or with glandular hairs 20

19. Leaves acuminate to mucronate; scapes 0.3–0.5 mm diameter; corolla tube glandular-hairy ..... **17. S. floribundum**
Leaves obtuse; scapes 0.6–4.5 mm diameter; corolla tube glabrous .. **18. S. inaequipetalum**

20. Inflorescence indeterminate, racemose; bracteoles present ..... **20. S. debile**
Inflorescence determinate, cymose; bracteoles absent 21

21. Scapes glandular-hairy 22
Scapes glabrous 24

22. Column with glandular and eglandular hairs; corolla tube 3–3.5 mm long ..... **14. S. leptorrhizum**
Column glabrous; corolla tube 1.4–2.5 mm long 23

23. Labellum attached at base of anterior sinus; paracorolla present ..... **16. S. multiscapum**
Labellum attached to outside of corolla tube; paracorolla absent .... **15. S. austrocapense**

24. Sepals glabrous; inflorescence branches glandular-hairy; glands capitate; anterior petals 4.1–4.5 mm long; labellum glabrous ..... **22. S. ornatum**
Sepals glandular-hairy; inflorescence branches glabrous; glands ellipsoidal; anterior petals 2.5–3 mm long; labellum glandular-hairy 25

25. Petals glandular-hairy; column 5.5–6.5 mm long; tropical Queensland ..... **21. S. velleioides**
Petals glabrous; column 4.5–5.5 mm long; Darling Downs & N.S.W. ..... **19. S. paniculatum**

Stylidium sect. **Floodia** Mildbr., Pflanzenr. 35: 41 (1908). **Type:** *S. floodii* F.Muell.

Rootstock cylindrical. Leaves linear, sessile, borne on terminal rosette and/or cauline. Glandular hairs present, glands ellipsoidal. Inflorescence determinate; flowers pedicellate; corolla tube with sinus on anterior side only; petals usually entire and obtuse, all free; labellum attached at base of anterior sinus, basal appendages absent (except *S. desertorum*). Paracorolla present or absent. Column lateral lobes absent; spur absent. Anther cells 4. Stigma sessile. Capsule obovoid to obconical; seeds globose to ellipsoidal, brown to black.

14 species, all indigenous to tropical Australia.

1. Stylidium foveolatum A.R.Bean **sp. nov.** *S. clarksonii* affinis sed scapis hypanthiis lobisque calycis glabris, petalis angustioribus, capsulis costatis et sepalis omnibus liberis differens. **Typus:** Queensland. Cook District: NE of Vrilya Point, Cape York, 11°11'S 142°09'E, 26 August 1981, *A. Morton* AM1446 & *M. Godwin* (holo: BRI; iso: MEL)

Herbaceous annual, 16–25 cm high. Glandular hairs 0.1–0.2 mm long; glands ellipsoidal. Stems present, glabrous. Leaves 20–200 per plant, scattered along stems, linear, 6.5–14 mm long, 0.3–0.5 mm wide, glabrous, apex obtuse, base truncate, margins entire. Petioles absent. Scapes 2–5 per plant, 0.4–0.7 mm in diameter, glabrous. Sterile bracts absent. Inflorescences 10 cm long including scape, determinate, monochasially cymose or determinate, dichasially cymose; branches glabrous. Bracts linear, 2.5–6 mm long, glabrous, obtuse. Bracteoles absent. Pedicels 1–4 mm long, glabrous. Hypanthium obovoid to ellipsoidal, glabrous. Sepals lanceolate, all free, 2–2.7 mm long, 0.3–0.5 mm wide, glabrous, obtuse. Corolla pink, glabrous or glandular-hairy on tube only; tube 1–1.5 mm long, with sinus on anterior side only. Paracorolla absent or continuous, lobed, thin, glabrous, c. 0.3 mm high. Paracorolla lobes or appendages single or absent. Paracorolla glands absent. Labellum attached at base of anterior sinus of corolla tube, ovate, 0.4–0.5 mm long, thick, glandular-hairy, obtuse. Labellum basal appendages absent. Petals all free, A1+A2+P1+P2. Anterior petals 2.3–3.6 mm long, 0.8–1 mm wide, entire, obtuse. Posterior petals 2.8–3.8 mm long, 0.9–1 mm wide, entire, obtuse. Column 5–6 mm long, of uniform width throughout, glandular-hairy; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule obconical or ellipsoidal, with 5 raised ribs, 4.2–5 mm long excluding sepals, 1.8–2 mm wide; halves detaching distally, not recurved. Seeds ellipsoidal, 0.4 mm long, brown or black, deeply pitted. Fig 1 F-I.

***Additional specimen examined*: Queensland.** Cook District: Skardon River, Cape York, on Venture Mining Barge Landing, Apr 1994, *Gunness* AG2303 (BRI).

***Reconstituted or spirit material examined*:** *Gunness* AG2303 (2 fls), *Morton* AM1446 & *Godwin* (2 fls).

***Distribution and habitat*:** *S. foveolatum* is confined to north-western Cape York Peninsula, north of Weipa (Map 1). It occurs on the ecotone between mangroves and *Melaleuca viridiflora* woodland, on damp sand.

***Phenology*:** Flowers and capsules recorded for April and August.

***Affinities*:** *S. foveolatum* is closest to *S. clarksonii*, with which it shares the very distinctive black, deeply pitted seeds. It differs from *S. clarksonii* by the glabrous scapes, hypanthia and sepals, the narrower petals, the ribbed capsules, and the sepals all free from each other.

***Conservation status*:** Data Deficient (DD) category according to the International Union for Conservation of Nature and Natural Resources (Anon. 1994).

***Etymology*:** The specific epithet is from the Latin *foveolatus*, meaning minutely pitted. This is in reference to the seeds.

2. Stylidium clarksonii Lowrie & Kenneally, Nuytsia 11: 204 (1997). **Type:** Queensland. Cook District: 4.7 km south of the Chester River crossing on the road east of the McIlwraith Range towards Nesbit River, 13°41'S 143°28'E, 21 June 1993, *J.R. Clarkson* 10108 & *V.J. Neldner* (holo: PERTH; iso: BRI, DNA).

Herbaceous annual, 20–35 cm high. Glandular hairs 0.15–0.25 mm long; glands ellipsoidal. Stems present, glabrous. Leaves 20–200 per plant, mostly in terminal rosette, with some scattered below or scattered along stems, linear, 9.5–24 mm long, 0.3–0.6 mm wide, glabrous, apex obtuse or acute, base truncate, margins entire. Petioles absent. Scapes 1–5 per plant, 0.6–0.7 mm in diameter, glabrous. Sterile bracts absent. Inflorescences 5–13 cm long including scape, determinate, monochasially cymose or determinate, dichasially cymose; branches glabrous. Bracts linear, 1.5–7.5 mm long, glabrous, acute. Bracteoles absent. Pedicels 2–4 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals lanceolate, with 3 free and 2 mostly fused, 1.5–2.6 mm long, 0.4–0.6 mm wide, glandular-hairy, obtuse. Corolla pink or mauve, glandular-hairy on tube and petals; tube 1.5–2.2 mm long, with sinus on anterior side only. Paracorolla continuous, lobed, thick, minutely papillose, c. 0.2 mm high. Paracorolla lobes or appendages 2, all similar, obtuse, none opposite the anterior petals, 2 opposite the posterior petals. Paracorolla glands absent. Labellum attached at base of anterior sinus of

corolla tube, ovate, 0.5–0.7 mm long, thick, glandular-hairy, obtuse or acute. Labellum basal appendages absent. Petals all free, A1+A2+P1+P2. Anterior petals 2.7–4.2 mm long, 1.5–2.7 mm wide, entire, obtuse. Posterior petals 2.8–4.7 mm long, 1.3–2.5 mm wide, entire, obtuse. Column 4.5–5.5 mm long, of uniform width throughout, glandular-hairy; lateral lobes absent; spur absent. Stigma sessile. Corona absent or not extending beyond anthers. Capsule obconical or ellipsoidal, without raised ribs, 3.7–6 mm long excluding sepals, 1.5–2 mm wide; halves detaching distally, not recurved. Seeds ellipsoidal, 0.4–0.5 mm long, black, deeply pitted.

***Specimens examined*: Queensland.** Cook District: c. 8.5 km NW of Kennedy River bridge, between Laura and Coen, Jul 1998, *Bean* 13494 (BRI, MEL); 5.3 km SE of Hann River, on Laura-Coen road, Jul 1998, *Bean* 13530 (BRI, NSW); 28 km S of Coen, on road to Laura, Jul 1998, *Bean* 13569 (BRI); c. 15 km upstream from the upper crossing at Massy Creek on Silver Plains station, Sep 1979, *Clarkson* 2643B (BRI, PERTH, QRS); Lakefield N.P., 5 km SE of Morehead River, May 1987, *Clarkson* 7033 & *Simon* (BRI, L, MBA, NSW, PERTH); 5.2 km S of the Hann River on the Laura to Musgrave road, May 1989, *Clarkson* 8006 & *Neldner* (BRI, DNA, K, L, MBA, PERTH); 0.9 km E of the Peninsula Development road, on an IWS track 0.5 km N of Laura River crossing, Apr 1983, *Clarkson* 4734 (BRI); Bamboo Range, N of Musgrave on Peninsula Development road, Jul 1993, *Forster* PIF13451 (BRI, MEL); 1 km N of last Scrubby Creek crossing, Silver Plains station, Jul 1993, *Forster* PIF13635 & *Sankowsky* (BRI, MEL); base of Round Mtn, Embley Range, Silver Plains station, Jul 1997, *Forster* 21394 (BRI, DNA, QRS); northern side of Nesbit River, Silver Plains, Jun 1998, *Forster* PIF23002 et al. (BRI, DNA, MEL, NSW, QRS); Isabella Falls, Aug 1976, *Scarth-Johnson* 302A (BRI); 25 km S of Musgrave, Peninsula Development road, Aug 1985, *Williams* 85130 (BRI).

***Reconstituted or spirit material examined*:** *Clarkson* 7033 & *Simon* (2 fls); *Clarkson* 8006 & *Neldner* (2 fls); *Clarkson* 10108 & *Neldner* (2 fls); *Forster* PIF13451 (2 fls).

***Distribution and habitat*:** *S. clarksonii* is endemic to south-eastern Cape York Peninsula, between latitudes 13°30'S and 15°30'S (Map 1). It inhabits woodland dominated by *Eucalyptus* or *Melaleuca*, sometimes near small creeks or in seepage areas. Soils are invariably sandy.

***Phenology*:** Flowers have been recorded from April to September. Capsules have been recorded from May to August.

***Affinities*:** *S. clarksonii* is most closely related to *S. foveolatum*. Both species have very distinctive black, deeply pitted seeds.

***Conservation status*:** A widespread species which is not considered to be at risk.

3. Stylidium rubriscapum W.Fitzg., Jour. & Proc. Roy. Soc. Western Australia 3: 218 (1918). **Type:** Western Australia. Calder River; Messmate Creek in the Packhorse Range; undated, *W.V. Fitzgerald* (syn: ?PERTH n.v.).

Herbaceous annual, 10–20 cm high. Glandular hairs 0.15–0.25 mm long; glands ellipsoidal. Stems present, glabrous. Leaves 20–200 per plant, mostly in terminal rosette, with some scattered below or scattered along stems, linear, 5–12 mm long, 0.5–1 mm wide, glabrous, apex acute or acuminate, base truncate, margins entire. Petioles absent. Scapes c. 7 per plant, 0.3–0.6 mm in diameter, glabrous. Sterile bracts absent. Inflorescences 5–15 cm long including scape, 1-flowered. Bracteoles present, c. 1.2 mm long. Pedicels 50–150 mm long, glabrous. Hypanthium obovoid to ellipsoidal, glabrous. Sepals lanceolate or ovate or elliptical, all free, 1.5–2.5 mm long, 0.7–1 mm wide, glandular-hairy, acute. Corolla pink or red, glandular-hairy on tube and petals; tube c. 1.8 mm long, with sinus on anterior side only. Paracorolla continuous, lobed, thin, minutely papillose, c. 0.5 mm high. Paracorolla lobes or appendages 3, all similar, acute, 2 opposite the anterior petals, 1 opposite the posterior petals. Paracorolla glands absent. Labellum attached at base of anterior sinus of corolla tube, ovate, c. 0.5 mm long, thick or thin, glabrous; obtuse. Labellum basal appendages absent. Petals with posterior ones fused, A1+A2+(P1/P2). Anterior petals 3.3–3.5 mm long, 1.6–1.9 mm wide, entire, acute. Posterior petals 3.3–3.5 mm long, 1.5–1.7 mm wide, entire, obtuse. Column c. 7 mm long, of uniform width throughout, glandular-hairy; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule ellipsoidal, without raised ribs, c. 4 mm long excluding

sepals, c. 2 mm wide; halves detaching distally, not recurved. Seeds not seen.

***Specimens examined*: Western Australia.** Galvins Gorge, c. 200 km E of Derby, Jul 1974, *Carr* 4175 & *Beauglehole* 47953 (DNA).

***Reconstituted or spirit material examined*:** *Carr* 4175 & *Beauglehole* 47953 (2 fls).

***Distribution and habitat*:** *S. rubriscapum* is endemic to the northern Kimberley of Western Australia (Map 7). It inhabits moist areas in grassy woodland.

***Phenology*:** Flowers and capsules have been recorded from July to September.

***Affinities*:** The linear leaves and floral features of *S. rubriscapum* place it clearly in *S.* sect. *Floodia*, but it differs from all other members of the group by its solitary inflorescences.

4. Stylidium rivulosum Lowrie & Kenneally, Nuytsia 11: 213 (1997). **Type:** Western Australia. On the road to Pago Mission (abandoned) from Honeymoon Beach on the margins of Unamon Creek, 14°06'S 126°43'E, 26 June 1994, *A. Lowrie* 1022 (holo: PERTH; iso: DNA, MEL).

Notes: No material of this species was available for examination. See Lowrie & Kenneally (1997) for a description and illustration.

***Distribution and habitat*:** *S. rivulosum* is endemic to the northern Kimberley of Western Australia (Map 2). It grows near creeks on skeletal sandstone or in shallow sandy soils.

5. Stylidium mucronatum Lowrie & Kenneally, Nuytsia 11: 206 (1997). **Type:** Western Australia. Grevillea Creek, c. 35 km NW of Beverley Springs Station, 16°33'S 125°10'E, 7 June 1995, *A. Lowrie* 1188 (holo: PERTH; iso: DNA, MEL).

Notes: No material of this species was available for examination. See Lowrie & Kenneally (1997) for a description and illustration.

***Distribution and habitat*:** *S. mucronatum* is endemic to the Kimberley region of Western Australia (Map 6). It grows on creekbanks in sandy soil.

6. Stylidium floodii F.Muell., Fragm. 1: 149 (1859); *Candollea floodii* (F.Muell.) F.Muell., Syst. Census Austral. Pl. 86 (1883). **Type:** Northern Territory. Roper River, Gulf of Carpentaria, [14° —'S 134° —'E], July 1856, *F. Mueller* (lecto: MEL, fide Kenneally & Lowrie, 1994).

Herbaceous annual, 8–20 cm high. Glandular hairs 0.15–0.2 mm long; glands ellipsoidal. Stems present or absent (with leaves in basal rosette), glabrous. Leaves 20–200 per plant, mostly in terminal rosette, with some scattered below, linear, 22–35 mm long including petiole (if any), 0.3–0.7 mm wide, glabrous, apex obtuse or acute or acuminate, base truncate, margins entire. Petioles absent. Scapes 1–12 per plant, 0.3–1 mm in diameter, glandular-hairy. Sterile bracts absent. Inflorescences 5–17 cm long including scape, determinate, monochasially cymose or determinate, dichasially cymose; branches glandular-hairy. Bracts linear or deltate or ovate, 1.5–4 mm long, glabrous or glandular-hairy, obtuse or acute or mucronate. Bracteoles absent. Pedicels 2–9 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals deltate or lanceolate, all free, 0.9–1.7 mm long, 0.3–0.6 mm wide, glandular-hairy, obtuse. Corolla pink, glandular-hairy on tube and petals; tube 1.3–2.7 mm long, with sinus on anterior side only. Paracorolla continuous, lobed, thin, glabrous, 0.2–0.5 mm high. Paracorolla lobes or appendages 4 or 5, all similar, obtuse, 2 opposite the anterior petals, 2 or 3 opposite the posterior petals. Paracorolla glands absent. Labellum attached at base of anterior sinus of corolla tube, ovate, 0.3–0.7 mm long, thick, glabrous or glandular-hairy, obtuse or acute. Labellum basal appendages absent. Petals all free, A1+A2+P1+P2. Anterior petals 0.9–2.2 mm long, 0.5–1.2 mm wide, entire, obtuse. Posterior petals 1.5–3.3 mm long, 0.9–1.9 mm wide, entire, obtuse. Column 5–8 mm long, of uniform width throughout, with eglandular hairs; lateral lobes absent; spur absent. Stigma sessile. Corona absent or not extending beyond anthers. Capsule ellipsoidal, without raised ribs, 2–2.9 mm long excluding sepals, 1.1–1.8 mm wide; halves detaching distally, not recurved. Seeds globose, 0.2–0.25 mm long, brown, smooth or colliculate.

***Specimens examined*: Northern Territory**. 21 km N of Limmen Bight River, Sep 1986, *Clark* 687 (BRI, DNA); Arnhem Land, Koolatong River crossing, Numbulwar Rd, Oct 1987, *Clark* 1622 (DNA); Amungee Mungee waterhole, May 1991, *Cowie* 1819 & *Wilson* (DNA); Koolatong River, near road crossing, Oct 1996, *Cowie* 7360 (DNA); Ngukurr, 20 km NE crossing of Turkey Lagoon Creek, Aug 1987, *Russell-Smith* 3082 & Lucas (BRI, DNA); 3 km S of Bing Bong homestead, May 1984, *Thomson* 517 (DNA); Lake Eames area, 1 km east, Vanderlin Island, Jul 1988, *Thomson* 2499 (DNA). **Queensland**. BURKE DISTRICT: Richmond-Croydon road, 76.8 km S of "Esmeralda", Jul 1998, *Bean* 13443 (BRI); Richmond-Croydon road, 47.9 km N of "Esmeralda", Jul 1998, *Bean* 13470 (BRI, DNA); Croydon, Aug 1936, *Blake* 12472 (BRI); Adel's Grove, via Camooweal, Jun 1950, *De Lestang* 475 (BRI); 89 km W of Croydon, on road to Normanton, Jun 1991, *Halford* Q492 (BRI); Gulf Highway, 108 km SE of Normanton, Jul 1974, *Ollerenshaw* 1482 et al. (BRI, CANB); 23 km NW of "Old Corinda" station, along the Doomadgee-Woologorang road, May 1974, *Pullen* 9119 (BRI, CANB). COOK DISTRICT: One Hundred Mile swamp, near Undara resort, E of Mt Surprise, Jul 1998, *Bean* 13760 & *Fox* (BRI); 37 km SSW of "Lyndhurst" HS and 1 km E of highway, Aug 1976, *Lazarides* 8171 (BRI, CANB); 16 km W of Georgetown, May 1976, *Scarth-Johnson* 152A (BRI). NORTH KENNEDY DISTRICT: c. 4 miles [6 km] E of Wairuna and c. 0.5 miles [0.8 km] south scarp facing Burdekin, Aug 1967, *Morain* 185 (BRI).

***Reconstituted or spirit material examined*:** *Bean* 13443 (2 fls); *Halford* Q492 (3 fls); *Morain* 185 (3 fls); *Pullen* 9119 (3 fls).

***Distribution and habitat*:** *S. floodii* occurs in the area surrounding the Gulf of Carpentaria, including north-eastern Northern Territory, and north Queensland as far east as 'Wairuna', west of Cardwell (Map 1). It grows in damp sandy soil, in woodland dominated by *Melaleuca viridiflora* or *Eucalyptus* spp., or along creekbanks.

***Phenology*:** Flowers and capsules have been recorded from May to October.

***Conservation status*:** A widespread species which is not considered to be at risk.

7. Stylidium symonii Carlquist, Aliso 9: 439 (1979). **Type:** Northern Territory. At old B.H.P. flying field, Arnhem Land, 12°54'S 135°28'E, 17 June 1972, *D.E. Symon* 7731 (holo: DNA).

Notes: No material of this species was available for examination. See Carlquist (1979) for a description.

***Distribution and habitat*:** *S. symonii* is known only from the type locality in north-eastern Arnhem Land (Map 2). Habitat is unknown.

8. Stylidium delicatum A.R.Bean **sp. nov.** S. floodii affinis, a quo foliis brevioribus, columna glabra vel pilis glandulosis longioribus et sepalis apice acuto ad mucronato differt. **Typus:** Queensland. COOK DISTRICT: 2.8 km along new Pennefather River road, N of Weipa, 12°20'S 141°53'E, 11 July 1998, *A.R. Bean* 13579 (holo: BRI (1 sheet + spirit); iso: DNA, MEL, NSW).

Stylidium sp. (Sanamere Lagoon J.R. Clarkson 6175) in Henderson (1997).

Herbaceous annual, 10–20 cm high. Glandular hairs 0.3–0.5 mm long; glands ellipsoidal. Stems present, glabrous. Leaves 20–200 per plant, mostly in terminal rosette, with some scattered below, linear, 10–25 mm long, 0.3–0.7 mm wide, glabrous, apex acuminate, base truncate, margins entire. Petioles absent. Scapes 1–6 per plant, 0.3–0.5 mm in diameter, glandular-hairy. Sterile bracts absent or present. Inflorescences 3.5–13 cm long including scape, determinate, monochasially or dichasially cymose; branches glandular-hairy. Bracts deltate or lanceolate, 1–4 mm long, glandular-hairy, mucronate. Bracteoles absent. Pedicels 3–7 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals deltate or lanceolate or elliptical, all free or with 3 free and 2 mostly fused, 1.3–2 mm long, 0.3–0.6 mm wide, glandular-hairy, acute. Corolla pink, glandular-hairy on tube and petals; tube 2.4–3 mm long, with sinus on anterior side only. Paracorolla continuous, lobed, thin, glabrous, 0.3–0.8 mm high. Paracorolla lobes or appendages 3–5, all similar, acute or obtuse, 0–2 opposite the anterior petals, 2 or 3 opposite the posterior petals. Paracorolla glands absent. Labellum attached at base of anterior sinus of corolla tube, ovate, 0.5–0.7 mm long, thick, glabrous or glandular-hairy, obtuse or acute. Labellum basal appendages absent. Petals all free,

A1+A2+P1+P2. Anterior petals 1.3–2.6 mm long, 0.9–1.5 mm wide, entire, obtuse. Posterior petals 2–4 mm long, (1.2–)1.8–2.7 mm wide, entire, obtuse. Column 5–7 mm long, of uniform width throughout, glabrous or glandular-hairy; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule obconical or ellipsoidal, without raised ribs, 2.5–3 mm long excluding sepals, 1.2–1.7 mm wide; halves detaching distally, not recurved. Seeds ellipsoidal, 0.2–0.25 mm long, brown, smooth and lacunose. Fig. 1 A-D.

***Specimens examined*: Queensland.** Cook District: Vyce's Crossing c. 13 km due north of Weipa, Jul 1998, *Bean* 13574 (AD, BRI, DNA, MEL, NSW, QRS); Brown's Creek, Pascoe River, Jul 1948, *Brass* 19548 (A, BRI); c. 26 km SSW of Aurukun and 3 km W of Archer River, Oct 1982, *Clarkson* 4548; Cowal Creek crossing on the Bamaga to Mutee Head road, Sep 1985, *Clarkson* 6208 (BRI, QRS); Sanamere Lagoon, c. 3 km N of the Jardine River crossing on road to Bamaga, Aug 1985, *Clarkson* 6175 (BRI); 3.6 km S of old road crossing of Jardine River, Jul 1992, *Clarkson* 9698 & *Neldner* (BRI, DNA, MBA); Site 13, Pennefather River, Jul 1988, *Dalliston* CC276 (BRI); Sandy Creek, 69 km from Weipa on road to Stones Crossing, Jul 1993, *Forster* PIF13502 & *Sankowsky* (BRI); east arm of Namaleta Creek, upstream of Venture Mine lease, Oct 1994, *Gunness* AG2404 (BRI); along Kennedy road, c. 18 km N of Moreton Telegraph Station, Aug 1978, *Kanis* 2042 (BRI, CANB, L); Lake Boronto, 25 km NE of Bamaga, Aug 1978, *Paijmans* 3042 (BRI, CANB); Pascoe River, Sep 1990, *Sankowsky* 1154 & *Sankowsky* (BRI); Bamaga and tip of Cape York, Sep 1980, *Scarth-Johnson* 1043A (BRI, DNA); 13.5 km ENE of Weipa Mission, Jul 1974, *Specht* W433 & *Salt* (BRI); Schramm Creek, branch of Batavia River, undated, *Whitehouse* s.n. (BRI).

***Reconstituted or spirit material examined*:** *Bean* 13574 (2 fls); *Bean* 13579 (2 fls); *Clarkson* 4548 (2 fls); *Clarkson* 4896 (2 fls); *Clarkson* 6175 (1 fl); *Clarkson* 6208 (2 fls); *Clarkson* 9698 & *Neldner* (2 fls); *Forster* 13502 & *Sankowsky* (2 fls).

***Distribution and habitat*:** *S. delicatum* is endemic to northern Cape York Peninsula, north from about Aurukun (Map 5). It is recorded from swamp margins, *Melaleuca* woodland or open heathland, usually on sandy soil, but also recorded from clay-loam.

***Phenology*:** Flowers and capsules have been recorded from July to October.

***Affinities*:** *S. delicatum* is closely related to *S. floodii*, but differs by its leaves 10–25 mm long (22–35 mm for *S. floodii*); glandular hairs 0.3–0.5 mm long (0.15–0.2 mm for *S. floodii*); acute to acuminate sepals (obtuse for *S. floodii*); and the glabrous or glandular-hairy column (column with eglandular hairs only for *S. floodii*).

S. delicatum differs from *S. rivulosum* by its longer, acute sepals; 3–5 lobed paracorolla (2–lobed for *S. rivulosum*); the free posterior petals and the shorter column of uniform width throughout and lacking eglandular hairs.

***Conservation status*:** A widespread species which is not considered to be at risk.

***Etymology*:** The specific epithet is from the Latin *delicatus*, meaning delicate or dainty, in reference to the overall appearance of the plant.

9. Stylidium turbinatum Lowrie & Kenneally, Nuytsia 11: 215 (1997). **Type:** Western Australia. 1.5 km ESE of the Elephant Rock end of the Sleeping Buddha hill formation south of Kununurra, 15°50'S 128°46'E, 25 April 1995, *A. Lowrie* 1095 (holo: PERTH n.v.; iso: DNA, MEL).

Herbaceous annual, 6–16 cm high. Glandular hairs 0.15–0.25 mm long; glands ellipsoidal. Stems present, glabrous. Leaves 20–200 per plant, mostly in terminal rosette, with some scattered below, linear, 10–23 mm long, 0.3–0.7 mm wide, glabrous, apex acute or mucronate, base truncate, margins entire. Petioles absent. Scapes 1–10 per plant, 0.3–0.5 mm in diameter, glandular-hairy. Sterile bracts absent. Inflorescences 6–10 cm long including scape, determinate, monochasially cymose; branches glandular-hairy. Bracts linear or deltate, 1–2.5 mm long, glandular-hairy, acute or mucronate. Bracteoles absent. Pedicels 3–8 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals deltate or lanceolate, all free, 1.2–1.9 mm long, 0.5–0.8 mm wide, glandular-hairy, obtuse or acute. Corolla pink, glandular-hairy on tube and petals; tube 1.6–2 mm long, with sinus on anterior side only. Paracorolla continuous, lobed, thin, minutely papillose, 0.3–0.4 mm high. Paracorolla lobes or appendages 3–6, all similar, acute or obtuse, 0–2 opposite the anterior petals, 2–4 opposite the posterior petals. Paracorolla glands absent. Labellum attached

Fig 1. ***Stylidium delicatum*** A. whole plant x 1. B. lateral view of flower x 5. C. dehiscing capsule x 5. D. seed x 50. ***Stylidium foveolatum***. F. whole plant x 0.5. G. lateral view of flower x 5. H. capsule x 5. I. seed x 25. A,C,D from *Gunness* AG2404; B from *Clarkson* 9698; E from *Forster* 22591 & *Booth*; F-I from *Gunness* AG2303.

at base of anterior sinus of corolla tube, ovate, 0.5–0.6 mm long, thick, glabrous or glandular-hairy, obtuse. Labellum basal appendages absent. Petals all free, A1+A2+P1+P2 or posterior ones fused, A1+A2+(P1/P2). Anterior petals 2–3 mm long, 1.3–2 mm wide, entire, acute or obtuse. Posterior petals 2.8–4 mm long, 1.9–3 mm wide, bilobed or entire, obtuse. Column 5–7.5 mm long, slightly dilated near distal end, with glandular and eglandular hairs; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule obconical, with 5 raised ribs, 2.2–3.3 mm long excluding sepals, 1.7–2 mm wide; halves detaching distally, not recurved. Seeds ellipsoidal, 0.2–0.25 mm long, yellow or brown, smooth.

***Selected specimens*: Western Australia**. c. 32 km WSW of Kununurra, Jul 1976, *Beauglehole* 54296 (DNA); S side of Cockburn Range, c. 6.5 km W of King R., Jul 1974, *Carr* 3405 & *Beauglehole* 47183 (DNA). **Northern Territory**. Survey Creek, Daly River road, May 1968, *Byrnes* NB661 (DNA); Stuart Highway, 40 km S of Darwin, Jun 1977, *Carlquist* 15178 (DNA); Site 55, Mary River, May 1989, *Clark* 1751 (DNA); tributary of Allia Ck, May 1994, *Cowie* 4886 & *Albrecht* (DNA); 9.5 km S of Twin Fall, May 1980, *Craven* 5858 (CANB, DNA); 65 km NE of Pine Creek, May 1977, *Dunlop* 4560 (DNA, NSW); Mt Gilruth area, Jun 1978, *Dunlop* 4911 (DNA); Koolpinyah station, May 1996, *Egan* 5331 (DNA); Magela Creek at Mudginberry, May 1973, *Hartley* 13874 (DNA); c. 8 miles [13 km] SSW of Oenpelli-Pine Creek intersection, Jul 1973, *Henry* 890 (DNA); Radon Gorge area, c. 12 km S of Jabiru, Jun 1978, *Latz* 7693 (BRI, CANB, DNA); Tortilla Flats, Apr 1974, *Parker* 410 (DNA); Flying Fox Creek, Arnhem Hwy, Jun 1977, *Parker* 899 (CANB, DNA); 4 km W of Nabarlek airstrip, Oenpelli road, Apr 1979, *Rankin* 2141 (DNA, PERTH); Howard River area, Aug 1979, *Rankin* 2230 (DNA); Munmarlary turnoff, Arnhem Highway, Jun 1983, *Rankin* 2726 (DNA); Koongarra, Jun 1978, *Rice* 2686 (DNA); Kakadu N.P., upper Koolpin Creek, Jun 1988, *Russell-Smith* 5530 & *Lucas* (BRI, DNA).

***Reconstituted or spirit material examined*:** *Dunlop* 4560 (1 fl); *Parker* 899 (1 fl); *Rankin* 2141 (2fls).

***Distribution and habitat*:** *S. turbinatum* is distributed from the Kununurra area of Western Australia to the Arnhem Land plateau in Northern Territory (Map 2). It grows on sandstone plateaux, on moist flats or near creeks. Soils are sandy and associated species may include *Eucalyptus ptychocarpa* F.Muell., *E. polycarpa* F.Muell., *Melaleuca* spp. and *Pandanus spiralis* R.Br.

***Phenology*:** Flowers and capsules have been recorded from April to August.

***Affinities*:** *S. turbinatum* differs from *S. floodii* by the minutely papillose paracorolla (glabrous for *S. floodii*), the anterior petals 1.3–2 mm wide (0.5–1.2 for *S. floodii*), the column slightly dilated near distal end and with glandular and eglandular hairs (uniform width throughout and with eglandular hairs for *S. floodii*) and the capsule obconical and conspicuously angled (ellipsoidal and not angled for *S. floodii*).

10. Stylidium costulatum Kenneally & Lowrie, Nuytsia 9: 343-345 (1994). **Type:** Western Australia. Wonganut Spring, 19 km ESE of Coulomb Point, Dampier Peninsula, 17°25'S 122°19'E, 18 June 1984, *K.F. Kenneally* 9054/A (holo: PERTH n.v.; iso: MEL).

Herbaceous annual, 5–15 cm high. Glandular hairs 0.2–0.3 mm long; glands ellipsoidal. Stems present, glabrous. Leaves 20–200 per plant, mostly in terminal rosette, with some scattered below, linear, 7–26 mm long, 0.5–0.8 mm wide, glabrous, apex acute or acuminate, base truncate, margins entire. Petioles absent. Scapes 1–8 per plant, 0.4–0.7 mm in diameter, glandular-hairy. Sterile bracts absent. Inflorescences 2–10 cm long including scape, determinate, monochasially cymose; branches glandular-hairy. Bracts linear or lanceolate, 1–4 mm long, glandular-hairy, acute. Bracteoles absent. Pedicels 3–9 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals lanceolate or elliptical, with 3 free and 2 mostly fused, 1.5–2 mm long, 0.6–0.7 mm wide, glandular-hairy, acute. Corolla yellow, glandular-hairy on tube and petals; tube 1.7–2.2 mm long, with sinus on anterior side only. Paracorolla discontinuous, lobed, thick, glabrous, 0.2–0.3 mm high. Paracorolla lobes or appendages 2, all similar, obtuse, 2 opposite the anterior petals, none opposite the posterior petals. Paracorolla glands absent. Labellum attached at base of anterior sinus of corolla tube, ovate, 0.4–0.6 mm long, thick or thin, glabrous or glandular-hairy, obtuse. Labellum basal appendages absent. Petals with posterior ones fused, A1+A2+(P1/P2). Anterior petals 1.8–2.5 mm long, 1.2–1.5 mm wide, entire, obtuse. Posterior petals 2.8–3 mm long, 1.4–1.7

mm wide, entire, obtuse. Column 5–6.5 mm long, slightly dilated near distal end, glandular-hairy; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule obconical or ellipsoidal, with 5 raised ribs, 3–4.5 mm long excluding sepals, 1.5–2 mm wide; halves detaching distally, not recurved. Seeds globose or ellipsoidal, c. 0.2 mm long, brown, smooth or colliculate.

***Specimens examined*: Western Australia.** 59 km by road N of Gibb River road, Meda-Oobagooma road, c. 60 km NE of Derby, Jun 1976, *Beauglehole* 52685 (DNA); Wonganut Spring, 19 km ESE of Coulomb Point, Dampier Peninsula, Jun 1984, *Forbes* 2372 (MEL).

***Reconstituted or spirit material examined*:** *Beauglehole* 52685 (1 fl); *Forbes* 2372 (3 fls).

***Distribution and habitat*:** *S. costulatum* is endemic to the western parts of the Kimberley in Western Australia (Map 1). It grows adjacent to creeks in seasonally wet areas.

***Phenology*:** April to August, according to Kenneally & Lowrie (1994).

***Affinities*:** *S. costulatum* is closely related to *S. turbinatum*, but differs by having 2 sepals mostly fused (all sepals free for *S. turbinatum*), corolla yellow (pink for *S. turbinatum*), paracorolla discontinuous, glabrous, 2-lobed (continuous, papillose, 3–6 lobed for *S. turbinatum*), posterior petals 1.4–1.7 mm wide (1.9–3 mm for *S. turbinatum*) and column with glandular hairs only (glandular and eglandular for *S. turbinatum*).

11. Stylidium desertorum Carlquist, Aliso 9: 317 (1978). **Type:** Northern Territory. Salt Beef Lake, Tanami, 20°53'S 130°25'E, 22 July 1973, *P.K. Latz* 4085 (holo: AD; iso: BRI).

Herbaceous perennial, 15–26 cm high. Glandular hairs 0.3–0.7 mm long; glands ellipsoidal. Stems present, glabrous. Leaves 20–200 per plant, mostly in terminal rosette, with some scattered below, linear, (11–)16–75 mm long, 0.3–0.8 mm wide, glabrous, apex mucronate, base truncate, margins entire. Petioles absent. Scapes 1–6 per plant, 1–2.3 mm in diameter, glandular-hairy. Sterile bracts absent or present. Inflorescences 13–20 cm long including scape, determinate, monochasially cymose or determinate, dichasially cymose; branches glandular-hairy. Bracts linear or deltate or ovate, 1–5 mm long, glandular-hairy, acute or mucronate. Bracteoles absent. Pedicels 2–9 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals deltate or lanceolate or elliptical, all free, 2.2–2.7 mm long, 0.7–0.8 mm wide, glandular-hairy, obtuse or acute. Corolla pink, glandular-hairy on tube and petals; tube 4.2–5.5 mm long, with sinus on anterior side only. Paracorolla absent. Labellum attached at base of anterior sinus of corolla tube, ovate or orbicular, 0.4–1 mm long, thick, glandular-hairy, obtuse or acuminate. Labellum basal appendages less than half length of labellum or more than half length of labellum, glabrous or minutely papillose. Petals all free, A1+A2+P1+P2. Anterior petals 2.2–4 mm long, 0.8–1.8 mm wide, entire, obtuse. Posterior petals 3–5 mm long, 1–2.2 mm wide, entire, obtuse. Column 11–15 mm long, of uniform width throughout, glabrous; lateral lobes absent; spur absent. Stigma sessile. Corona absent or extending beyond anthers. Capsule obconical or ellipsoidal, without raised ribs, 3.5–4.7 mm long excluding sepals, 1.7–2.5 mm wide; halves detaching distally, not recurved. Seeds globose or ellipsoidal, 0.2–0.25 mm long, brown, smooth or colliculate.

***Selected specimens*: Western Australia.** Kimberley Division, 19°52'S 125°15'E, May 1984, *Fatchen* 960 (AD); Red Dune site, near Edgar Range, SE of Broome, Aug 1976, *Kenneally* 5572 (MEL, PERTH); N of Balgo Mission, Jul 1973, *Latz* 4042 (DNA). **Northern Territory**. c. 84 km WNW of Green Swamp well, Tanami Desert, Aug 1995, *Albrecht* 6973 (DNA, NT); 9.6 miles [15.4 km] N of Georgina Downs HS, Oct 1957, *Chippendale* 3813 (AD, BRI, DNA, MEL); Ooratippra Stn, Sandover Hwy, Arganara Creek, Aug 1979, *Henshall* 2718 (DNA, MEL); 12 [miles?] SE Rabbit Flat, Jul 1973, *Latz* 3946 (BRI, CANB, DNA, PERTH); north-west Simpson Desert, Nov 1973, *Latz* 4422 (AD, CANB, DNA, NSW); Elliott, May 1975, *Latz* 5971 (AD, DNA, NT); Phillips Creek station (Old Mission), Jun 1975, *Latz* 6045 (AD, DNA); 2 km N of Wauchope roadhouse, Stuart Highway, Jun 1978, *Latz* 7831 (DNA); Kurluparranka Soak, Lander River floodout, Aug 1991, *Latz* 12142 (MEL, NT); Thring swamp, Singleton station, Jun 1975, *Ulyatt* 28 (DNA, PERTH); 16 km W of McLaren Creek station, Nov 1984, *Waugh* s.n. (DNA); on Barkly Hwy 70 km NW of Barrys Caves near Radio repeater 8406, Sep 1981, *Whaite* 3934 (DNA, NSW); 50 km S of Kalkarindji, Aug 1993, *Wightman* 6187 (DNA).

Queensland. BURKE DISTRICT: Selwyn Ranges, grid ref. 7054-607993, Jul 1991, *Conroy* 89 & *Taylor* (BRI); 10 km S of Mt Isa, Feb 1985, *Harris* 40 (BRI). MITCHELL DISTRICT: Haughton Vale, Jundah, Sep 1997, *Groves* AZI 1530 (BRI). GREGORY NORTH DISTRICT: 6 km NNW of "Badalia", Sep 1977, *Purdie* 1105 (BRI). GREGORY SOUTH DISTRICT: 60 km E of Nappamerrie, Aug 1995, *Guy* s.n. (AD).

Reconstituted or spirit material examined: *Conroy* 89 & *Taylor* (2 fls); *Latz* 3946 (1 fl); *Wightman* 6187 (2 fls).

Distribution and habitat: *S. desertorum* has a scattered distribution in the semi-arid areas of Queensland, Northern Territory and Western Australia (Map 3). It grows adjacent to seasonal swamps or in areas which receive water runoff, or on sandplains in association with *Triodia* spp. Soils are usually sandy, but clays and clay-loams will also support the species.

Phenology: Flowers and capsules have been recorded from May to December.

Affinities: *S. desertorum* is closely related to *S. floodii*, but differs by the glandular hairs 0.3–0.7 mm long (0.15–0.2 mm for *S. floodii*), the sepals 2.2–2.7 x 0.7–0.8 mm (0.9–1.7 x 0.3–0.6 mm for *S. floodii*), corolla tube 4.2–5.5 mm long (1.3–2.7 mm for *S. floodii*) and basal appendages present on labellum (absent for *S. floodii*).

Conservation status: A widespread species which is not considered to be at risk.

12. Stylidium adenophorum Lowrie & Kenneally, Nuytsia 11: 199 (1997). **Type:** Western Australia. Mount Barnett Roadhouse picnic grounds, Kimberley, 16°45'S 125°56'E, 11 June 1995, *A. Lowrie* 1227 (holo: PERTH n.v.; iso: DNA, MEL).

Herbaceous annual, 10–20 cm high. Glandular hairs 0.2–0.4 mm long; glands ellipsoidal. Stems present, glabrous. Leaves 20–200 per plant, mostly in terminal rosette, with some scattered below or scattered along stems, linear, 13–25 mm long, 0.3–0.6 mm wide, glandular-hairy, apex obtuse, base truncate, margins entire. Petioles absent. Scapes 1–20 per plant, 0.5–0.8 mm in diameter, glandular-hairy. Sterile bracts absent. Inflorescences 10–18 cm long including scape, determinate, monochasially cymose or determinate, dichasially cymose; branches glandular-hairy. Bracts lanceolate or ovate, 1–3 mm long, glandular-hairy, obtuse or acute. Bracteoles absent. Pedicels 4.5–16 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals lanceolate or ovate, all free, 0.9–1.6 mm long, 0.5–0.7 mm wide, glandular-hairy, obtuse or acute. Corolla pink, glandular-hairy on tube and petals; tube 2.2–4 mm long, with sinus on anterior side only. Paracorolla discontinuous, lobed, thin, glabrous, 0.2–0.8 mm high. Paracorolla lobes or appendages 4–7, dimorphic, acute or obtuse, 2 opposite the anterior petals, 2–5 opposite the posterior petals. Paracorolla glands absent. Labellum attached at base of anterior sinus of corolla tube, ovate, 0.5–0.7 mm long, thick, glabrous or glandular-hairy, obtuse or acute. Labellum basal appendages absent. Petals with posterior ones fused, A1+A2+(P1/P2). Anterior petals 2–3.5 mm long, 0.8–1.9 mm wide, entire, obtuse. Posterior petals 2.5–4.5 mm long, (1.2–)1.9–3 mm wide, bilobed or entire, obtuse. Column 7–8 mm long, slightly dilated near distal end, with glandular and eglandular hairs; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule ellipsoidal, without raised ribs, 2.4–4.5 mm long excluding sepals, 1.7–2.1 mm wide; halves detaching distally, not recurved. Seeds globose, 0.2–0.25 mm long, brown, smooth.

Selected specimens: **Western Australia**. Wolf Creek Meteorite Crater, c. 85 km S of Halls Creek, Jul 1974, *Carr* 3592 & *Beauglehole* 47370 (DNA); Mount Brophy Springs, Gardner Range, 190 km SE of Halls Creek, Jul 1995, *Coate* 374 (BRI, DNA); Mt Parker Plateau, Jul 1991, *Cowie* 1990 (DNA); Camp Creek, Mitchell Plateau, 1 km N of Amax camp, May 1993, *Cowie* 4329 & *Brubaker* (CANB, DNA, PERTH); Claypan 5 km E of McHughs Bore, on track to Logues Springs, Aug 1976, *Kenneally* 5777 (BRI, PERTH); King Leopold Ranges, 8.5 miles [13.6 km] SE of Bedford Downs station, Jul 1959, *Lazarides* 6388 (BRI, CANB); 39 miles [62 km] SW of Gibb River station, May 1967, *Maconochie* 205 (DNA). **Northern Territory**. 36 km W of Cape Crawford, Carpentaria Hwy, May 1991, *Cowie* 1736 & *Wilson* (DNA); Barkly Tableland, upper Nicholson River area, Jun 1974, *Kanis* 1720 (CANB, DNA); Wessel Islands, Oct 1972, *Latz* 3520 (DNA); c. 27 km SW of "Calvert Hills" on the road to "Creswell Downs", May 1974, *Pullen* 9252 (CANB, DNA); Kilgour Gorge,

Mallapunyah station, May 1984, *Thomson* 583 (DNA). **Queensland**. Burke District: Richmond-Croydon road, 34.6 km S of "Esmeralda", Jul 1998, *Bean* 13455 (BRI, NSW); Westmoreland, Little Amphitheatre, May 1997, *Forster* PIF21144 & *Booth* (BRI, DNA). Cook District: 13.7 km N of Wakooka, north of Cooktown, Jul 1998, *Bean* 13658 (BRI, DNA, MEL, NSW); 36.3 km from Dixie station on the track to Killarney, Jun 1989, *Clarkson* 8153 & *Neldner* (BRI); 0.9 km W of Marmoss Creek, 25.1 km E of Kerr Point, Weipa, Apr 1991, *Clarkson* 9022 & *Neldner* (BRI, K, MBA, PERTH); 6 km N of Lilyvale on the track to Running Ck, Jun 1993, *Clarkson* 10096 & *Neldner* (BRI, MBA, PERTH); Bulleringa N.P., 80 km NW of Mt Surprise, Apr 1998, *Forster* 22560 & *Booth* (BRI); 24 km S of Wakooka Outstation, May 1993, *Neldner* 4050 (BRI, DNA, K, MBA, MEL, NSW, PERTH). North Kennedy District: 22.5 km SW of Pentland, Aug 1997, *Bean* 12275 (BRI, MEL); near Reeve's Lake, c. 25 km W of junction of Lolworth Creek and Burdekin River, NW of Charters Towers, Jul 1981, *Henderson* H2657 (BRI, CANB, K, MO). South Kennedy District: southern end of Lake Buchanan, Oct 1974, *Althofer* 660 (BRI); 0.6 km S of Oxenhope Outstation, May 1991, *Neldner* 3172 & *Thompson* (BRI). Mitchell District: "Rangeside", 10-18 km E of Torrens Creek, Apr 1981, *Rebgetz* 748 (BRI).

Reconstituted or spirit material examined: *Bean* 12275 (2 fls); *Bean* 13658 (1 fl); *Clarkson* 8153 & *Neldner* (2 fls); *Clarkson* 9022 & *Neldner* (2 fls); *Clarkson* 10096 & *Neldner* (2 fls); *Forster* 22560 & *Booth* (1 fl); *Neldner* 4050 (1 fl).

Distribution and habitat: *S. adenophorum* is distributed across northern Australia, from the western Kimberley to Cape York Peninsula, and in Queensland, south as far as Lake Buchanan (Map 4). It grows in sandy soil in seasonally wet *Melaleuca* or *Eucalyptus* woodland, but where the surface soil is often quite dry when the species reaches maturity.

Phenology: Flowers and capsules have been recorded from April to October.

Affinities: *S. adenophorum* is related to *S. floodii*, but differs by the glandular-hairy leaves (glabrous for *S. floodii*), discontinuous paracorolla with dimorphic lobes (continuous and lobes all similar for *S. floodii*), posterior petals partly fused (all petals free for *S. floodii*) and column with glandular and eglandular hairs (eglandular only for *S. floodii*).

Conservation status: A widespread species which is not considered to be at risk.

Stylidium sect. **Debilia** Mildbr., Pflanzenr. 35: 41 (1908) as "Debiles". **Type:** *S. debile* F.Muell.

Rootstock cylindrical. Leaves oblanceolate, elliptical or obovate, borne on terminal rosette and/or cauline. Glandular hairs present, glands ellipsoidal or capitate. Inflorescence determinate; flowers pedicellate; corolla tube with sinus on anterior side only or on both sides; petals entire and obtuse, all free; labellum usually attached at base of anterior sinus, basal appendages present or absent. Paracorolla present or absent. Column lateral lobes absent; spur absent. Anther cells 4. Stigma sessile. Capsule obovoid to obconical; seeds globose to ellipsoidal, brown.

10 species endemic to northern and eastern Australia

13. Stylidium semipartitum F.Muell., Fragm. 1: 147 (1859). **Type:** [Northern Territory]. In pascuis aridis ad flumen Victoriae, [15° —'S 129°—'E], in 1855, *F. Mueller, n.v.*

S. leptorrhizum var. *pilosum* Benth., Fl. Austral. 4: 16 (1868). **Type:** Van Diemen's Gulf, NW Coast, *A. Cunningham*, n.v.

[*S. leptorrhizum* auct. non F.Muell.]

Herbaceous annual or perennial, 9–40 cm high. Glandular hairs 0.2–0.5 mm long; glands ellipsoidal. Stems present, glandular-hairy. Leaves 10–30 per plant, mostly in terminal rosette, with some scattered below or scattered along stems, oblanceolate or elliptical or obovate, 11–50(–68) mm long including petiole, 3–21 mm wide, glandular-hairy, apex obtuse or acute, base obtuse or cuneate, margins entire. Petioles 5–20(–28) mm long. Scapes 1–18 per plant, 0.3–1 mm in diameter, glandular-hairy. Sterile bracts absent. Inflorescences 8–30 cm long including scape, determinate, monochasially cymose; branches glandular-hairy. Bracts deltate or lanceolate, 1–4 mm long, glandular-hairy, acute. Bracteoles absent. Pedicels 4–19 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals deltate or lanceolate or ovate, all free, 0.9–1.7 mm long, 0.4–0.6 mm wide, glandular-hairy, acute. Corolla pink or

mauve or red, glandular-hairy on tube and petals; tube 2.2–2.7 mm long, with sinus on anterior side only. Paracorolla discontinuous, lobed, thin, glabrous, 0.2–1.1 mm high. Paracorolla lobes or appendages 2 or 4, dimorphic, acute or obtuse, (0–)2 opposite the anterior petals, 2 opposite the posterior petals. Paracorolla glands absent. Labellum attached at base of anterior sinus of corolla tube, ovate or lanceolate, 0.4–0.7 mm long, thick or thin, glabrous or glandular-hairy, obtuse or acute. Labellum basal appendages absent. Petals with posterior ones fused, A1+A2+(P1/P2). Anterior petals 1.5–3.5 mm long, 0.6–1.9 mm wide, entire, acute or obtuse. Posterior petals 2.5–4.2 mm long, 1.5–2.8 mm wide, entire, obtuse. Column 5.5–7 mm long, of uniform width throughout, with eglandular hairs; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule ellipsoidal, without raised ribs, 2.5–6.2 mm long excluding sepals, 1.5–2.5 mm wide; halves detaching distally, not recurved. Seeds globose or ellipsoidal, 0.25–0.3 mm long, brown, colliculate.

***Selected specimens*: Western Australia**. 59 km by road N of Gibb River road, Molta-Oobagooma road, c. 60 km NE of Derby, Jun 1976, *Beauglehole* 52680 (DNA); Curlew Bay, 7 km NW of One Arm Point, Dampier Peninsula, May 1991, *Carter* 459 (DNA, PERTH); St Patrick Is., St George Basin, May 1995, *Coate* 249A (DNA, PERTH); claypan 5 km E of McHughs Bore, on track to Logues Springs, Aug 1976, *Kenneally* 5777 (DNA, PERTH); Bunda Bunda Mill, 33 km NE of Coulomb Point, Dampier Peninsula, Jun 1984, *Kenneally* 9060 (DNA, PERTH); Matchbox Creek, on road to Ord Dam 19.9 km SW of Victoria Hwy, Jun 1993, *Lowrie* 779 (BRI). **Northern Territory**. Along road from Darwin Water Supply dam, 7 km from junction with Stuart Hwy, Jun 1978, *Carlquist* 15198 (BRI, DNA); 61.8 miles [99.5 km] SW of Katherine, May 1960, *Chippendale* 6798 (BRI); near Plot 27, Mount Douglas, Mount Bundy station, May 1989, *Clark* 1723 (BRI, DNA); Site 53, Mary River, May 1989, *Clark* 1761 (BRI, DNA); Nabarlek, Apr 1989, *Hinze* 510 (BRI, DNA); Melville Island, near mouth of Maclear River, Apr 1986, *Johnson* 4200 (BRI); Munmalary station, Apr 1973, *Latz* 3893 (BRI); 66 km N of Timber Creek, May 1994, *Latz* 13929 & *Dunlop* (CANB, DNA); near Koongarra Saddle, 1.5 km N of Koongarra, May 1980, *Lazarides* 8898 (BRI, CANB); Gunn Point, Apr 1973, *McKean* 1048 (BRI, CANB, DNA); Bridge Creek, Stuart Highway, May 1977, *Parker* 842 (BRI, CANB, DNA); South Alligator Mine area, 7 km SE of UDP Falls, Jun 1977, *Parker* 881 (BRI, CANB, DNA); Jim Jim Falls, Kakadu, Oct 1984, *Wightman* 1719 & *Dunlop* (BRI, CANB, DNA); Arnhem Land, 3 km SE of Ramingining, Jun 1987, *Wightman* 3874 & *Smith* (DNA).

***Reconstituted or spirit material examined*:** *Clark* 1761 (2 fls); *Craven* 6503 (1 fl); *Dunlop* 3396 (2 fls); *Wightman* 1719 & *Dunlop* (3 fls); *Lazarides* 8898 (1 fl).

***Distribution and habitat*:** *S. semipartitum* is widespead in the northern parts of Northern Territory and the Kimberley region of Western Australia (Map 5). It grows on damp sand in eucalypt woodland, on sandstone plateaux with *Triodia* spp. or near creeks with *Melaleuca* spp.

***Phenology*:** Flowers and capsules have been recorded from March to August, with one record in October.

***Notes*:** The type of *S. semipartitum* could not be located at MEL, nor at K or BM. Despite this, the application of the name is clear due to the detailed description provided by Mueller. In particular, he stated that *semipartitum* has "leaf margins glandular-ciliate" and "leaves crowded at the apex of a short to very short stem". These character-states clearly distinguish it from *S. leptorrhizum*.

S. semipartitum was reduced to synonymy under *S. leptorrhizum* by Bentham (1868). Subsequently the name *S. leptorrhizum* was widely misapplied to the taxon with leaves on a stem, distinct petioles and glandular-hairy leaves, i.e. *S. semipartitum*.

***Affinities*:** *S. semipartitum* is distinctive within *S.* sect. *Debilia* because of its glandular-hairy leaves.

14. Stylidium leptorrhizum F.Muell., Fragm. 1: 148 (1859); *Candollea leptorrhiza* (F.Muell.) F.Muell., Syst. Census Austral. Pl. 86 (1883). **Type:** [Northern Territory]. near Macadams Range, [14°—'S 129°—'E], October 1855, *F. Mueller* (holo: MEL [MEL1061659]).

Stylidium barrettorum Lowrie & Kenneally, Nuytsia 11: 202 (1997), **syn. nov. Type:** Western Australia. Grevillea Creek, Beverley Springs Station, 31 May 1992, *M.D. Barrett* 4 (holo: PERTH; iso: DNA, MEL).

Herbaceous annual, 8–25 cm high. Glandular hairs 0.15–0.3 mm long; glands ellipsoidal. Stems absent (with leaves in basal rosette). Leaves 10–20 per plant, oblanceolate or elliptical, 14–39(–60) mm long including petiole, 3–9.5 mm wide, glabrous, apex acute or mucronate, base cuneate, margins entire. Petioles 3–13 mm long. Scapes 1–3 per plant, 0.4–0.8 mm in diameter, glandular-hairy. Sterile bracts absent. Inflorescences 8–25 cm long including scape, determinate, monochasially cymose; branches glandular-hairy. Bracts lanceolate, 1.5–4 mm long, glandular-hairy, acute or mucronate. Bracteoles absent. Pedicels 4–16 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals deltate or ovate or elliptical, all free, 1–1.5 mm long, 0.5–0.8 mm wide, glandular-hairy, acute. Corolla pink or mauve, glandular-hairy on tube and petals; tube 3–3.5 mm long, with sinus on anterior side only. Paracorolla discontinuous, lobed, thin, glabrous, 0.8–1.5 mm high. Paracorolla lobes or appendages 2, both similar, acute or obtuse, opposite the anterior petals only. Paracorolla glands absent. Labellum attached at base of anterior sinus of corolla tube, ovate, 0.5–0.8 mm long, thick, glabrous; obtuse or acute. Labellum basal appendages absent. Petals with posterior ones fused, A1+A2+(P1/P2). Anterior petals 2.8–4 mm long, 1.8–2.5 mm wide, entire, obtuse. Posterior petals 3.2–5 mm long, 1.2–3 mm wide, entire, obtuse. Column 7–9.5 mm long, slightly dilated near distal end, with glandular and eglandular hairs; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule ellipsoidal, without raised ribs, 3.2–5 mm long excluding sepals, 2–2.2 mm wide; halves detaching distally, not recurved. Seeds ellipsoidal, c. 0.2 mm long, yellow or brown, smooth or colliculate.

***Specimens examined*: Western Australia.** King Edward River, c. 50 km NE of Mitchell River HS, Aug 1978, *Beauglehole* 29109 & *Errey* 2809 (DNA); 11 km E of junction of Gibb River-Drysdale-El Questro road, c. 195 km SW of Wyndham, May 1976, *Beauglehole* 51639 (DNA). **Northern Territory.** Spirit Hills Conservation area, near Victoria River, Aug 1996, *Boehme* 9 (DNA); Alligator Springs, Jul 1995, *Booth* 1078 (DNA).

***Reconstituted or spirit material examined*:** *Beauglehole* 29109 & *Errey* 2809 (2 fls); *Boehme* 9 (2 fls).

***Distribution and habitat*:** *S. leptorrhizum* grows in the Kimberley region of Western Australia and in the Victoria River district of Northern Territory (Map 3). It grows in sandy soil beside creeks or billabongs.

***Phenology*:** Flowers have been recorded from May to August; capsules from July to August.

***Typification*:** The type specimen of *S. leptorrhizum* has glabrous leaves, columns with glandular hairs, capsules 3–4 mm long, and broad acute sepals. Examination of the type of *S. barrettorum* reveals it is clearly conspecific with *S. leptorrhizum*.

***Affinities*:** *S. leptorrhizum* is closely related to *S. multiscapum*, but differs by the acute sepals (obtuse for *S. multiscapum*), corolla tube 3–3.5 mm long (1.4–2.5 mm for *S. multiscapum*), paracorolla lobes 2 (6–8 for *S. multiscapum*), labellum ovate and glabrous (orbicular and glandular-hairy for *S. multiscapum*), column with glandular and eglandular hairs (glabrous for *S. multiscapum*) and capsule 2–2.2 mm wide (1.4–1.7 mm for *S. multiscapum*).

15. Stylidium austrocapense A.R.Bean **sp. nov.** *S. multiscapae* affinis, sed foliis brevioribus angustioribusque, paracorolla deficienti, labello parti exterioro corollae afixo, appendicibus basalibus labelli plerumque praesentibus et seminibus majoribus, differens. **Typus:** Queensland. Cook District: c. 17 km ESE of Wolverton, c. 1.5 km S of Pratt Tin Mine, 13°24'S 143°02'E, 21 April 1993, *J.R. Clarkson* 9960 & *V.J. Neldner* (holo: BRI; iso: DNA, K n.v., MBA, PERTH n.v.).

Herbaceous annual, 9–18 cm high. Glandular hairs 0.2–0.4 mm long; glands ellipsoidal. Stems absent (with leaves in basal rosette). Leaves 4–40 per plant, oblanceolate or elliptical, 7.5–31 mm long including petiole, 2–10 mm wide, glabrous, apex acuminate or mucronate, base cuneate, margins entire. Petioles 1.5–7 mm long. Scapes 1–10 per plant, 0.3–0.7 mm in diameter, glandular-hairy. Sterile bracts absent. Inflorescences 9–18 cm long including scape,

determinate, monochasially cymose; branches glandular-hairy. Bracts ovate or deltate, 1–2 mm long, glandular-hairy, obtuse or acute or mucronate. Bracteoles absent. Pedicels 2–13 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals lanceolate or elliptical, all free, 0.9–1.6 mm long, 0.4–0.7 mm wide, glandular-hairy, obtuse or acute. Corolla pink or red, glandular-hairy on tube and petals; tube 1.5–2.1 mm long, with sinus on anterior side only. Paracorolla absent. Labellum attached to outside of corolla tube, orbicular, 0.3–0.7 mm long, thick, glabrous or glandular-hairy, obtuse. Labellum basal appendages absent or present, less than half length of labellum, glabrous. Petals all free, A1+A2+P1+P2. Anterior petals 2.4–3.5 mm long, 1.5–2.9 mm wide, entire, obtuse. Posterior petals 3–4.1 mm long, 1.9–3.5 mm wide, entire, obtuse. Column 5–7.5 mm long, of uniform width throughout, glabrous; lateral lobes absent; spur absent. Stigma sessile. Corona absent or extending beyond anthers. Capsule ellipsoidal, without raised ribs, 2.2–3.7 mm long excluding sepals, 1.3–2 mm wide; halves detaching distally, not recurved. Seeds globose or ellipsoidal, 0.25–0.3 mm long, yellow or brown, colliculate. Fig. 2 F-G.

***Specimens examined*: Queensland.** Cook District: Emu Creek, 10.2 km from Peninsula Development road, towards 'Dixie', Jul 1998, *Bean* 13554 (BRI); 7.9 km S of Musgrave, on road to Laura, Jul 1998, *Bean* 13557 (BRI, DNA, MEL, NSW); 11.5 km west of the Laura to Musgrave road on the track to Dixie, Jun 1989, *Clarkson* 8119 & *Neldner* (BRI, MBA); 24.7 km N of the Morehead River on the Peninsula Development road, Apr 1991, *Clarkson* 8927 & *Neldner* (BRI, MBA); Bulleringa NP, 80 km NW of Mt Surprise, track to Red River past Donkey Spring, Apr 1998, *Forster* PIF22591 & *Booth* (BRI); 8 miles [13 km] E of Musgrave Telegraph Office, Jun 1968, *Pedley* 2659 (BRI).

***Reconstituted or spirit material examined*:** *Bean* 13554 (2 fls); *Bean* 13557 (2 fls); *Clarkson* 8119 & *Neldner* (3 fls); *Clarkson* 9960 & *Neldner* (3 fls); *Forster* 22591 & *Booth* (2 fls).

***Distribution and habitat*:** *S. austrocapense* is confined to Cape York Peninsula between 13°S and 17°30'S latitude (Map 3). It inhabits low hills or intermittant watercourses with coarse white sandy soil. The dominant species include *Eucalyptus tetrodonta, E. clarksoniana, Melaleuca viridiflora, M. nervosa* and *Xanthorrhoea johnsonii.*

***Phenology*:** Flowers and capsules have been recorded from April to July

***Affinities*:** *S. austrocapense* is closely related to *S. multiscapum* but differs by the leaves 7.5–31 mm long (22–52 mm for *S. multiscapum*), paracorolla absent (present for *S. multiscapum*), labellum attached to outside of corolla tube (attached at base of anterior sinus for *S. multiscapum*) and labellum basal appendages usually present (rarely present for *S. multiscapum*).

S. austrocapense differs from *S. leptorrhizum* by the petals all free (posterior ones fused in *S. leptorrhizum*); paracorolla absent (present, discontinuous in *S. leptorrhizum*); labellum attached to outside of corolla tube (base of anterior sinus in *S. leptorrhizum*); labellum basal appendages present (absent in *S. leptorrhizum*); column 5–6 mm long and glabrous (7–9.5 mm long with glandular and eglandular hairs in *S. leptorrhizum*).

***Conservation status*:** A widespread species which is not considered to be at risk.

***Etymology*:** The specific epithet refers to the occurrence of the species on the southern part of Cape York Peninsula.

16. Stylidium multiscapum O.Schwarz, Repert. Spec. Nov. Regni Veg. 24: 105 (1927). **Type:** Port Darwin, 6 miles [10 km] east, [12°2-'S 130°5-'E], undated, *F.A.K. Bleeser* 360 (holo: B, destroyed; iso: NSW).

Herbaceous annual, 10–20 cm high. Glandular hairs 0.2–0.5 mm long; glands ellipsoidal. Stems absent (with leaves in basal rosette). Leaves 8–100 per plant, oblanceolate, 22–52 mm long including petiole, 6.5–8 mm wide, glabrous, apex acute or mucronate, base cuneate, margins entire. Petioles 5–10 mm long. Scapes 1–8 per plant, 0.5–0.8 mm in diameter, glandular-hairy. Sterile bracts absent. Inflorescences 10–20 cm long including scape, determinate, monochasially cymose; branches glandular-hairy. Bracts ovate, 1–2 mm long, glandular-hairy, obtuse or acute. Bracteoles

absent. Pedicels 1.5–6 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals lanceolate or elliptical, all free, 1.2–1.6 mm long, 0.5–0.6 mm wide, glandular-hairy, obtuse. Corolla pink, glandular-hairy on tube and petals; tube 1.4–2.5 mm long, with sinus on anterior side only. Paracorolla discontinuous, lobed, thin, glabrous, 0.5–1.1 mm high. Paracorolla lobes or appendages 6–8, all similar, acute, 2–4 opposite the anterior petals, 4 opposite the posterior petals. Paracorolla glands absent. Labellum attached at base of anterior sinus of corolla tube, orbicular, 0.5–0.7 mm long, thick, glandular-hairy, obtuse. Labellum basal appendages absent. Petals all free, A1+A2+P1+P2. Anterior petals 2.4–3.3 mm long, 1.8–2.1 mm wide, entire, obtuse. Posterior petals 2.7–4.1 mm long, 1.8–2.4 mm wide, entire, obtuse. Column 4–7.5 mm long, of uniform width throughout, glabrous; lateral lobes absent; spur absent. Stigma sessile. Corona absent or extending beyond anthers. Capsule ellipsoidal, without raised ribs, 1.8–2.8 mm long excluding sepals, 1.4–1.7 mm wide; halves detaching distally, not recurved. Seeds ellipsoidal, c. 0.2 mm long, brown, lacunose.

***Selected specimens*: Western Australia**. Kununurra-Timber Creek road, 1.5 km W of Lake Argyle turnoff, Jul 1974, *Carr* 3078 & *Beauglehole* 46837 (DNA); 72 miles [115 km] NNW of Gibb River station, Sep 1954, *Speck* 4952 (DNA). **Northern Territory.** Shoal Bay, Sep 1980, *Andrew* 202 (CANB, DNA); 9 miles [14 km] N of Mudginberry HS, Jul 1972, *Byrnes* 2742 (DNA); 4 km W of Blythe River crossing, Jul 1987, *Clark* 1270 & *Wilson* (DNA); Kapalga, May 1977, *Collins* BC446 (DNA); Jim Jim Creek, Mar 1982, *Dunlop* 6206 & *Taylor* (DNA); Keep River N.P., Jarrnarm area, Jun 1995, *Egan* 5034 (DNA); Keep River N.P., Flying Fox Creek, Jun 1995, *Egan* 5073 (DNA); c. 250 m S of homestead, Swim Creek station, Jun 1991, *Jobson* 1362 (MEL); Wessel Islands, Oct 1972, *Latz* 3371 (BRI, DNA, MEL); Umbakumba, Groote Eylandt, Aug 1973, *Levitt* 344 (DNA); Conservation Commission carpark, Palmerston, May 1989, *Madrill* 2 (DNA); Thoraks Reserve, 12 miles [19 km] E of Darwin, Jun 1964, *Nelson* 1095 (DNA); 8 miles [13 km] N of Cooper Ck, Oct 1962, *Paine* s.n. (DNA); McMillans Road area, Darwin, Sep 1977, *Parker* 1092 (CANB, DNA, NSW, PERTH); 1.6 km E of Oenpelli Mission, Jun 1972, *Symon* 7970 (DNA); Cadell River crossing on Maningrida road, Oct 1981, *Thomson* 146 (DNA); Spirit Hills Station, Aug 1987, *Wilson* 736 (DNA). **Queensland.** Nicholson River area, Jun 1974, *Henshall* 251 (DNA).

***Reconstituted or spirit material examined*:** *Dunlop* 6206 & *Taylor* (2 fls); *Egan* 5034 (1 fl); *Egan* 5073 (2 fls).

***Distribution and habitat*:** *S. multiscapum* is distributed from the eastern Kimberley, through the northern parts of Northern Territory, to extreme north-western Queensland (Map 6). It grows in damp sand in *Eucalyptus* dominated woodlands, often near creeks or adjacent to swamps.

***Phenology*:** Flowers and capsules have been recorded from May to October, and there is one record from March.

***Affinities*:** *S. multiscapum* is closely related to *S. leptorrhizum*. See notes under that species.

17. Stylidium floribundum R.Br., Prodr. 569 (1810); *Candollea floribunda* (R.Br.) F.Muell., Syst. Census Austral. Pl. 86 (1883). **Type:** [Northern Territory]. North Island, Sir Edward Pellew Group, [15°3-'S 136°5-'E], 20 December 1802, *R. Brown* (holo: BM (2 sheets); iso: MEL [MEL1061579]).

Herbaceous annual, 7–18 cm high. Glandular hairs 0.2–0.3 mm long; glands ellipsoidal. Stems absent (with leaves in basal rosette). Leaves 6–30 per plant, oblanceolate or obovate, 8–35(–48) mm long including petiole, 4–11 mm wide, glabrous, apex acute or acuminate or mucronate, base cuneate, margins entire. Petioles 2–22 mm long. Scapes 1–20 per plant, 0.3–0.5 mm in diameter, with simple hairs. Sterile bracts absent or present. Inflorescences 7–18 cm long including scape, determinate, monochasially cymose; branches glandular-hairy or with glandular and simple hairs. Bracts deltate or lanceolate or ovate, 1–4 mm long, glandular-hairy or with simple hairs, acute. Bracteoles absent. Pedicels 1.5–5.5 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals deltate or lanceolate, all free, 1.2–1.6 mm long, 0.4–0.5 mm wide, glandular-hairy, obtuse or acute. Corolla pink or yellow, glandular-hairy on tube and petals; tube 1–1.4 mm long, with sinus on anterior side only. Paracorolla absent. Labellum attached at base of anterior sinus of corolla tube, lanceolate and with slender tail,

0.4–0.6 mm long, thick, glabrous or glandular-hairy; terminal appendage present, 0.3–0.5 mm long, acute or acuminate. Labellum basal appendages less or more than half length of labellum, glabrous. Petals all free, A1+A2+P1+P2. Anterior petals 2.1–2.9 mm long, 0.9–1.5 mm wide, entire, acute or obtuse. Posterior petals 3–3.7 mm long, 1.3–1.8 mm wide, entire, acute or obtuse. Column 4.5–5.5 mm long, of uniform width throughout, glabrous; lateral lobes absent; spur absent. Stigma sessile. Corona absent or extending beyond anthers. Capsule obconical or ellipsoidal, without raised ribs, 3.5–5.5 mm long excluding sepals, 1.1–1.7 mm wide; halves detaching distally, not recurved. Seeds ellipsoidal, c. 0.25 mm long, brown, smooth or colliculate.

***Specimens examined*: Western Australia.** Mount Brophy Springs, Gardner Range, 190 km SE of Halls Creek, Jul 1995, *Coate* 367 (BRI, DNA, PERTH); 48 miles [77 km] N of Turkey Creek Police Station, Jul 1949, *Perry* 2516 (BRI, DNA). **Northern Territory**. near Hayes Creek, Jul 1946, *Blake* 16408 (BRI); 32 miles [51 km] SW of Hookers Creek, Jul 1956, *Chippendale* 2238 (BRI, DNA); McArthur River area, Jun 1976, *Craven* 4023 (BRI, CANB, DNA); Nicholson River area, Jun 1974, *Henshall* 367 (DNA); Newcastle Waters Station, May 1975, *Henshall* 998 (DNA); Powell Creek, Central Australia, 1894, *Holtze* (MEL); 47 km S of Elliot, Stuart Highway, Jun 1974, *Latz* 5498 (DNA); MacAdam Range, 1855, *Mueller* (MEL); sources of the Wentworth River, Gulf of Carpentaria, undated, *Mueller* (MEL); South Bay, Bickerton Island, Gulf of Carpentaria, Jun 1948, *Specht* 485 (AD, BRI, MEL); Lake Eames area, 2 km NE of lake, Vanderlin Island, Jul 1988, *Thomson* 2515, 2524 (DNA, NT). **Queensland**. Burke District: Mica Creek, 10 km S of Mt Isa, Sep 1983, *Schmid* 739 (BRI).

***Reconstituted or spirit material examined*:** *Craven* 4023 (2 fls); *Schmid* 739 (2 fls); *Thomson* 2515 (2 fls).

***Distribution and habitat*:** *S. floribundum* is distributed across northern Australia from the Kimberley to north-western Queensland (Map 8). It inhabits swampy flats or creek-beds, dominated by *Melaleuca* spp. or less commonly, *Eucalyptus* spp., always in sandy soils.

***Phenology*:** Flowers and capsules have been recorded from May to September.

***Affinities*:** *S. floribundum* is closely related to *S. inaequipetalum* but differs by the scapes 0.3–0.5 mm diameter (0.6–4.5 mm for *S. inaequipetalum*), corolla glandular-hairy on tube and petals (glandular-hairy on petals only for *S. inaequipetalum*), labellum lanceolate, acute (ovate, obtuse for *S. inaequipetalum*) and the mostly yellow flowers (pink for *S. inaequipetalum*).

***Conservation status*:** There are few collections in Australian Herbaria of this species and it is probably uncommon. However, its distribution is wide, so it is not thought to be of conservation concern at present.

18. Stylidium inaequipetalum J.M.Black, Trans. & Proc. Roy. Soc. South Australia 62: 106 (1938). **Type:** Northern Territory. near Ayers Rock, 25°21' S 131°02' E, 13 June 1937, *J.B. Cleland* (holo: AD).

Herbaceous perennial, 7–40 cm high. Glandular hairs 0.2–0.4 mm long; glands ellipsoidal. Stems absent (with leaves in basal rosette). Leaves 20–100 per plant, oblanceolate, 15–81 mm long including petiole, 2–8 mm wide, glabrous, apex obtuse or acute, base cuneate, margins entire. Petioles 12–45 mm long. Scapes 1–11 per plant, 0.6–4.5 mm in diameter, with simple hairs. Sterile bracts absent or present. Inflorescences 7–40 cm long including scape, indeterminate, branches monochasially cymose; branches glandular-hairy. Bracts lanceolate or ovate, 1.5–9.5 mm long, glandular-hairy, acute. Bracteoles absent. Pedicels 1.5–7 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals deltate or ovate, all free, 1.2–1.4 mm long, 0.5–0.7 mm wide, glandular-hairy, obtuse. Corolla pink, glandular-hairy on petals only; tube 1.1–1.5 mm long, with sinus on anterior side only. Paracorolla absent. Labellum attached at base of anterior sinus of corolla tube, ovate, 0.5–0.7 mm long, thick, glabrous; obtuse. Labellum basal appendages less or more than half length of labellum, glabrous. Petals all free, A1+A2+P1+P2. Anterior petals 1–2.4 mm long, 0.5–0.9 mm wide, entire, obtuse. Posterior petals 2.9–5.9 mm long, 1.7–3 mm wide, entire, obtuse. Column 4–7.5 mm long, of uniform width

throughout, glabrous; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule ellipsoidal, without raised ribs, 3.5–5.3 mm long excluding sepals, 1.3–1.8 mm wide; halves detaching distally, not recurved. Seeds globose or ellipsoidal, 0.25–0.3 mm long, brown, smooth.

***Selected specimens*: Northern Territory.** Valley of the Winds, Mt Olga, May 1985, *Bates* 5615 (AD); Kathleen Springs area, George Gill Range, Jul 1968, *Beauglehole* 26910 (DNA); Mt Connor, c. 220 km SW of Alice Springs, Jun 1974, *Carr* 1849 & *Beauglehole* 45628 (DNA); Ayers Rock, Jun 1935, *Cleland* s.n. (AD); MacDonnells Range [near Haast Bluff], 1872, *Giles* (MEL); Mt Currie, Sep 1974, *Henshall* 765 (DNA); Napperby Station, May 1975, *Henshall* 1020 (AD, DNA); Hull River, Aug 1973, *Latz* 4171 (AD, BRI, DNA, NSW, MEL); Alice Springs golfcourse, Jun 1974, *Latz* 5129 (DNA, NSW); Curtain Springs station, Sep 1974, *Latz* 5689 (AD, DNA); Stokes Creek, George Gill Ranges, Aug 1981, *Latz* 8756 (DNA); Maggi Springs, Ayers Rock, Jan 1969, *Maconochie* 649 (AD, BRI, DNA); c. 14 miles [22 km] W of Lasseters Cave, Petermann Ranges, Jan 1969, *Maconochie* 686 (DNA, K); Hull River, c. 12 km west of Docker River, Aug 1973, *Munir* 5181 (AD, DNA); Hull River near Lasserters Cave, Sep 1997, *Murfet* 2784 (AD, DNA); summit of Ayers Rock, c. 350 km SW of Alice Springs, Aug 1957, *Schodde* 397 (AD, K); Macdonnell Ranges, Jul 1894, *Tate* (AD, DNA); Kings Canyon, George Gill Range, Jul 1966, *Willis* (AD, MEL, NSW).

***Reconstituted or spirit material examined*:** *Beauglehole* 26910 (2 fls); *Murfet* 2784 (3 fls).

***Distribution and habitat*:** *S. inaequipetalum* is confined to the south-western parts of Northern Territory (Map 4). It grows on sheltered creekbanks in sand or amongst rocks, in or near the various ranges and mountains of the area.

***Phenology*:** Flowers and capsules have been recorded from almost every month of the year.

***Affinities*:** *S. inaequipetalum* is closest to *S. floribundum* (see notes under that species). It is also allied to the *S. debile* group. It differs from *S. paniculatum* by the scapes with simple hairs (glabrous for *S. paniculatum*), glandular-hairy inflorescence branches and bracts (glabrous for *S. paniculatum*), corolla glandular hairy on petals only (on tube only for *S. paniculatum*) and the glabrous labellum (glandular-hairy for *S. paniculatum*).

19. Stylidium paniculatum (Maiden & Betche) A.R.Bean **comb. et stat. nov.**

S. debile var. *paniculatum* Maiden & Betche, Proc. Linn. Soc. New South Wales 30: 367 (1905). **Type:** New South Wales. Boonoo Boonoo near Tenterfield, [28°4-'S 152°0-'E], February 1905, *J.L. Boorman* (holo: NSW; iso: BRI, MEL).

Herbaceous annual, 10–35 cm high. Glandular hairs 0.1–0.2 mm long; glands ellipsoidal. Stems present or absent (with leaves in basal rosette), glabrous. Leaves 6–30 per plant, scattered along stems, oblanceolate or obovate, 10–31 mm long including petiole, 3–9 mm wide, glabrous, apex obtuse or acute, base cuneate, margins entire. Petioles 3–10 mm long. Scapes 1 per plant, 0.4–0.9 mm in diameter, glabrous. Sterile bracts absent. Inflorescences 10–25 cm long including scape, indeterminate, branches monochasially cymose; branches glabrous. Bracts deltate or lanceolate or ovate, 1–3.5 mm long, glabrous, obtuse or acute. Bracteoles absent. Pedicels 2–3 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals lanceolate or elliptical, all free, 1–1.5 mm long, 0.4–0.6 mm wide, glandular-hairy, obtuse or acute. Corolla pink, glandular-hairy on tube only; tube 1.1–1.5 mm long, with sinus on anterior side only. Paracorolla absent. Labellum attached at base of anterior sinus of corolla tube, ovate or orbicular, 0.5–0.7 mm long, thick, glandular-hairy, obtuse. Labellum basal appendages less or more than half length of labellum, glabrous. Petals all free, A1+A2+P1+P2. Anterior petals 2–3.1 mm long, 1.2–2.4 mm wide, entire, obtuse. Posterior petals 2.9–4 mm long, 1.5–2.8 mm wide, entire, obtuse. Column 4.5–5.5 mm long, of uniform width throughout, glabrous or glandular-hairy; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule ellipsoidal, without raised ribs, 3.6–5.8 mm long excluding sepals, 1.1–1.7 mm wide; halves detaching distally, not recurved. Seeds ellipsoidal, c. 0.4 mm long, brown or black, colliculate. Fig. 2 A-B.

***Specimens examined*: Queensland**. Darling Downs District: Stanthorpe, Feb 1891, *Bailey* s.n. (BRI); Watson's Swamp, 6 km N of Amiens, Mar 1993, *Bean* 5852 & *Forster* (BRI, MEL); Sorrento Lane, west of

Dalveen, Apr 1998, *Bean* 13200 (BRI); Dunn's road, W of The Summit, Apr 1998, *Bean* 13206 (BRI); Wallangarra, Jan 1906, *Boorman* (NSW); Applethorpe, Swimming Hole, Nov 1946, *Everist & Webb* 1302 (BRI); Mt Norman firebreak track, Girraween N.P., Apr 1993, *Forster* PIF13275 (BRI); Sorrento Lane, along rabbit fence W of Dalveen, Feb 1994, *Grimshaw* PG470 (BRI); 9 km NW of Ballandean, Murphys Creek, Dec 1994, *Halford* Q2364 (BRI); Stanthorpe, Mar 1963, *Jones* s.n. (BRI); Fletcher, Jan 1977, *McDonald* 1759 (BRI). **New South Wales**. NORTHERN TABLELANDS: Severn S.F., Severn River Falls, Nov 1996, *Forster* PIF20115 (BRI, NSW); turnoff Brushabbers Road, Tenterfield to Jennings, Mar 1956, *Gray* 3726 (NSW); Maryland, undated, *Hickey* 2021 (BRI); Tompkins Gully, Maryland road, Jan 1992, *Wilson* 1303 & *Rowe* (NSW). NORTH COAST: Tooloom Falls, 5 miles [8 km] S of Urbenville, Dec 1965, *Constable* 6628 (NSW).

Reconstituted or spirit material examined: *Bean* 13200 (2 fls); *Forster* 13275 (2 fls); *Grimshaw* PG470 (3 fls); *McDonald* 1759 (2 fls).

Distribution and habitat: *S. paniculatum* apparently has a very restricted distribution, mainly between Dalveen (Queensland) and Tenterfield (New South Wales) on granite substrate at altitudes of between 800-1000 metres. In addition, collections from Severn River (further west) and from Tooloom Falls (further east) have been made (Map 7). It grows along creeks, drains or low-lying flats where the soil is sandy and moist for much of the year.

Phenology: Flowers and capsules have been recorded from November to April.

Affinities: *S. paniculatum* differs from *S. debile* by the paniculate inflorescence and the absence of bracteoles.

Conservation status: Data Deficient (DD) category according to the International Union for Conservation of Nature and Natural Resources (Anon. 1994).

20. Stylidium debile F.Muell., Fragm. 1: 149 (1859); *Candollea debilis* (F.Muell.) F.Muell., Syst. Census Austral. Pl. 86 (1883). **Type:** Queensland. MORETON DISTRICT: Brisbane River, [27°—'S 152° —'E], in 1856, *F. Mueller* (holo: MEL).

Herbaceous annual, 15–30 cm high. Glandular hairs 0.1–0.15 mm long; glands ellipsoidal. Stems present or absent (with leaves in basal rosette), glabrous. Leaves 20–200 per plant, scattered along stems, oblanceolate or obovate, 8–30 mm long including petiole, 3–7 mm wide, glabrous, apex obtuse or acute or mucronate, base cuneate, margins entire. Petioles 1.5–9 mm long. Scapes 1–2 per plant, 0.4–0.8 mm in diameter, glabrous. Sterile bracts absent. Inflorescences 10–25 cm long including scape, indeterminate, racemose. Bracts linear or lanceolate, 1.5–4.5 mm long, glabrous, obtuse or acute. Bracteoles present, 1.5 mm long. Pedicels 2.5–4 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals deltate or lanceolate, all free, 1–1.3 mm long, 0.5–0.7 mm wide, glandular-hairy, obtuse or acute. Corolla pink, glandular-hairy on tube and petals; tube 1.1–1.4 mm long, with sinus on anterior side only. Paracorolla absent. Labellum attached at base of anterior sinus of corolla tube, ovate or orbicular, 0.7–0.8 mm long, thick, glandular-hairy, obtuse. Labellum basal appendages less or more than half length of labellum, glabrous. Petals all free, A1+A2+P1+P2. Anterior petals 1.9–2.8 mm long, 1.2–2 mm wide, entire, obtuse. Posterior petals 2.7–3.3 mm long, 2–2.2 mm wide, entire, obtuse. Column 4.5–5.5 mm long, of uniform width throughout, glabrous or glandular-hairy; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule ellipsoidal, without raised ribs, 3.5–5 mm long excluding sepals, 1.2–1.8 mm wide; halves detaching distally, not recurved. Seeds ellipsoidal, 0.4–0.5 mm long, brown, colliculate.

Selected specimens: **Queensland.** COOK DISTRICT: Yungaburra, Sep 1934, *Coleman* s.n. (QRS); Bellenden-Ker Range, 1860-96, *Karsten* (MEL). LEICHHARDT DISTRICT: Mt Playfair, Nogoa River, 1890, *Biddulph* (MEL); Two Mile Creek, Blackdown Tableland, 12 miles [19 km] SSE of Bluff, Sep 1959, *Johnson* 983 (BRI); Blackdown Tableland, Mimosa Creek at road crossing, Jan 1983, *Telford* 9158 & *Butler* (CANB, MEL). PORT CURTIS DISTRICT: Rosedale, Sep 1930, *Dovey* X14 (BRI); Deepwater Creek N.P., c. 4 km N of campsite, Sep 1992, *Sharpe* 5334 (BRI, MEL). BURNETT DISTRICT: Eidsvold, undated, *Bancroft* (BRI); E116 Narayen, Nov 1973, *Tothill* N1308 (BRI). WIDE BAY DISTRICT: Prices Pool, 4 km S of Toolara Forest Station, near Gympie, Sep 1993, *Bean* 6471 (BRI, CANB); Yalanga station, Bates road, NE of Kin Kin, Dec 1994, *Bean* 8150 & *Grimshaw* (BRI); Epsilon L.A., S.F. 840, south-west of Bundaberg, Oct 1996, *Bean* 10999 (BRI, MEL); head of Stony Creek, 11

km N of Coalstoun Lakes, Apr 1983, *Forster* PIF1564 (BRI); S.F. 1294, Harwood Creek, c. 29.5 km SE of Childers, Feb 1996, *Sparshott* KMS741 & *Price* (BRI). MARANOA DISTRICT: Clayhole Creek, 20 miles [32 km] S of Yuleba, Nov 1958, *Johnson* 673 (BRI). DARLING DOWNS DISTRICT: North Dulacca, Oct 1963, *Hockings* s.n. (BRI). MORETON DISTRICT: White Rock, 3 km S of Redbank Plains, Ipswich, Jun 1990, *Bird* s.n. (BRI); near Sandgate, Brisbane, Nov 1960, *Blake* 21427 (BRI); 3 miles [5 km] NW of Greenbank, Mar 1960, *Pedley* 562 (BRI); Castle Hill range, c. 6 km W of Coolum Beach, Nov 1982, *Sharpe* 3269 & *Windolf* (BRI, NSW). **New South Wales.** NORTH COAST: Woodburn, Dec 1894, *Baeuerlen* (NSW); Evans Head, Nov 1972, *Coveny* 4660 (BRI, NSW); Wells Crossing, 1.6 km N of Halfway Creek, 29 km SSE of Grafton, Dec 1971, *Thurtell & Coveny* 3839 (BRI, NSW); Clarence River, undated, *Wilcox* (MEL). CENTRAL COAST: Alexandria Swamps, March 1888, *Fletcher* (NSW); Gosford State Nursery, Mar 1917, *Hamilton* (NSW); Botany Bay, undated, *Leichhardt* (MEL).

Reconstituted or spirit material examined: *Bean* 10999 (2 fls); *Bird* s.n. (2 fls); *Sharpe* 3269 & *Windolf* (2 fls).

Distribution and habitat: Recent herbarium collections (post-1960) indicate a distribution for *S. debile* from Blackdown Tableland and Deepwater National Park in Queensland to the Coffs Harbour region in New South Wales. Historical collections indicate additional occurrences on the Atherton Tableland and at Mt Playfair near Tambo, and as far south as Alexandria Swamps (33° 54'S) in Sydney (Map 8). It grows on creekbanks or in swampy areas often dominated by *Lophostemon suaveolens* or *Melaleuca quinquenervia*. Soils vary from sand to pale silty clay.

Phenology: Flowers and capsules have been recorded from every month of the year

Notes: Erickson (1958) and Stanberg (1992) described the seeds of *S. debile* as 'hairy'. However this is clearly not the case, and the seeds of *S. debile* are glabrous, as in all other *Stylidium* species.

S. debile is probably extinct on the Atherton Tableland, an area which has been extensively modified. It is probably also extinct in the greater Sydney area as there have been no herbarium records from this century, and it was not recorded by Benson and Howell (1994).

Conservation status: A widespread species which is not considered to be at risk.

21. Stylidium velleioides A.R.Bean **sp. nov.** *S. debili* affinis, sed differens inflorescentiis paniculatis, bracteolis deficientibus, columna longiore et petalis posterioribus longioribus. **Typus:** Queensland. NORTH KENNEDY DISTRICT: White Dam, "Princess Hills", west of Ingham, 18°19'S 145°22'E, 1 August 1998, *A.R.Bean* 13764 & *I. Fox* (holo: BRI; iso: DNA, K, MEL, NSW, QRS, distribuendi).

Herbaceous annual, 15–30 cm high. Glandular hairs 0.1–0.2 mm long; glands ellipsoidal. Stems present or absent (with leaves in basal rosette), glabrous. Leaves 6–30 per plant, scattered along stems, obovate, 8–33 mm long including petiole, 3.5–9 mm wide, glabrous, apex obtuse or acute, base cuneate, margins entire. Petioles 2–8 mm long. Scapes 1–3 per plant, 0.4–0.7 mm in diameter, glabrous. Sterile bracts absent. Inflorescences 15–25 cm long including scape, indeterminate, branches monochasially cymose; branches glabrous. Bracts lanceolate, 1–2.5 mm long, glabrous, obtuse. Bracteoles absent. Pedicels 2–6.5 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals deltate or lanceolate, all free, 1–1.3 mm long, 0.4–0.6 mm wide, glandular-hairy, acute. Corolla pink, glandular-hairy on tube and petals or glandular-hairy on petals only; tube 1.3–1.5 mm long, with sinus on anterior side only. Paracorolla absent. Labellum attached at base of anterior sinus of corolla tube, ovate or orbicular, 0.5–0.7 mm long, thick, glandular-hairy, obtuse. Labellum basal appendages more than half length of labellum, glabrous. Petals all free, A1+A2+P1+P2. Anterior petals 2.5–3 mm long, 1.4–2.2 mm wide, entire, obtuse. Posterior petals 3.3–4.4 mm long, 1.8–3 mm wide, entire, obtuse. Column 5.5–6.5 mm long, of uniform width throughout, glabrous or glandular-hairy; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule ellipsoidal, without raised ribs, 3.6–6.8 mm long excluding sepals, 1.2–1.5 mm wide; halves detaching distally, not recurved. Seeds globose or ellipsoidal, 0.4–0.5 mm long, brown, colliculate. Fig. 2 C-E.

Specimens examined: Queensland. BURKE DISTRICT: headwaters of Flinders River, 8.5 km E of "Reedy Springs" sign, Aug 1997, *Bean* 12267 (BRI). COOK

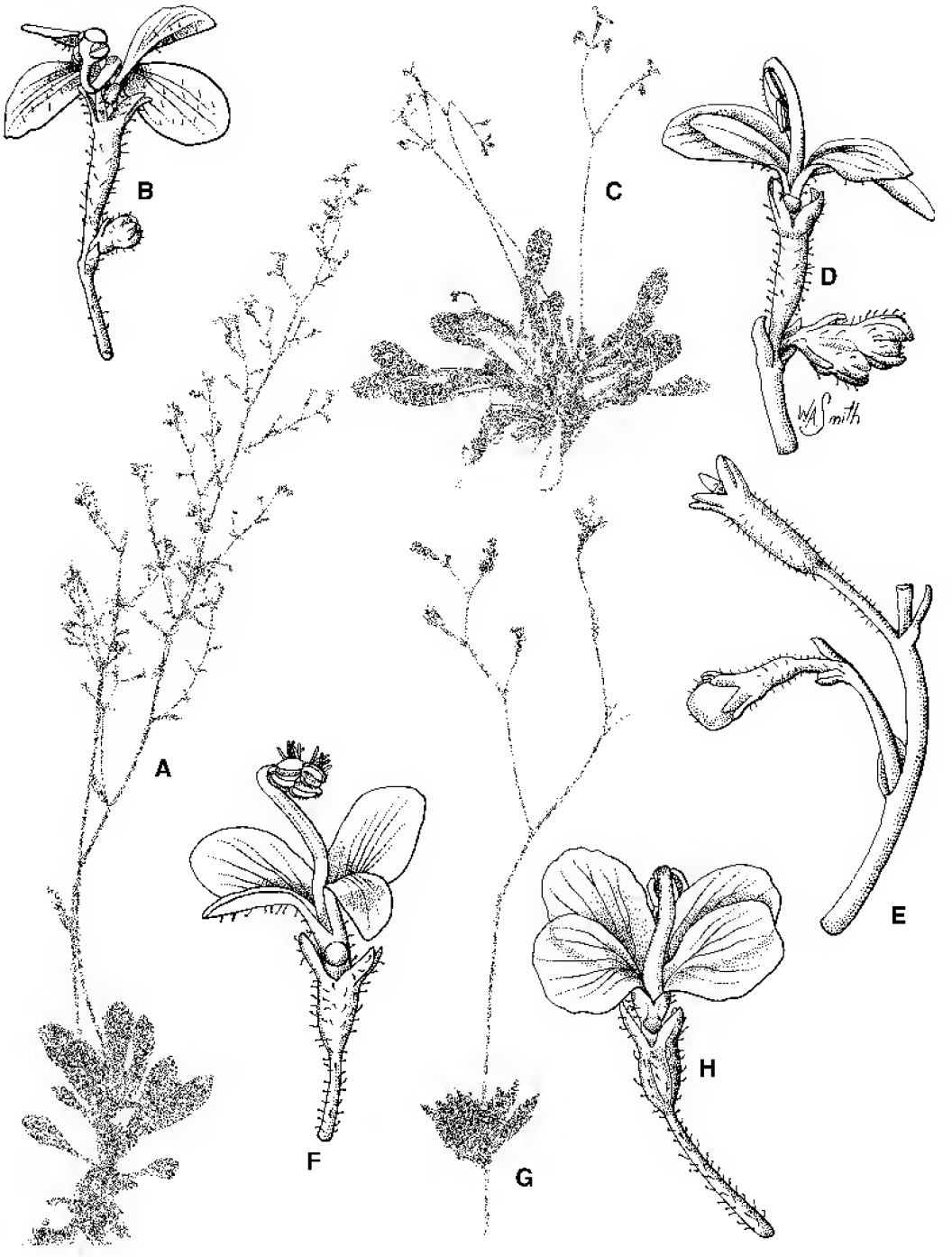

Fig. 2. ***Stylidium paniculatum*** A. whole plant x 0.5. B. lateral view of flower x 5. ***Stylidium velleioides*** C. whole plant x 0.5. D. lateral view of flower, and emerging buds x 5. E. bud and immature capsule x 5. ***Stylidium austrocapense*** F. whole plant x 1. G. lateral view of flower x 5. A from *Forster* 20115; B from *Bean* 13206; C-E from *Bean* 12267; F from *Clarkson* 9960 & *Neldner*; G from *Clarkson* 8119 & *Neldner*.

District: Mt Surprise, undated, *Armit* 848 (MEL); Red Camp Swamp, Yaramulla station, Jul 1981, *Williams* 81122 (BRI). North Kennedy District: 31.6 km from Hann Highway, towards "Clarke Hills", Aug 1997, *Bean* 12264 (BRI); Mt Fox, Sep 1949, *Clemens* s.n. (BRI); Port Denison, 1874, *Fitzalan* (MEL); Cleveland Bay, 1876, *Johnson* (MEL); Kelsey Creek, Proserpine district, undated, *Michael* 1488 (BRI); c. 45 miles [72 km] SE of Mt Garnet, Nov 1967, *Morain* 234 (BRI); Flinders Highway 43 km SW of Charters Towers, Jul 1974, *Ollerenshaw* 1093 & *Kratzing* (BRI, CANB); Charters Towers, Aug 1891, *Plant* s.n. (BRI). South Kennedy District: Clarke Range W of Cathu, Apr 1978, Byrnes 3814 & Clarkson (BRI); Slade Point dunal system, E of Finch Street, Mar 1993, *Champion* 806 (BRI); Dalrymple Heights, Jul-Nov 1947, *Clemens* s.n. (BRI); Laglan, c. 80 miles [129 km] W of Clermont, Oct 1960, *Everist* s.n. (BRI). Port Curtis District: 16.6 km by road W of 'Waverley' towards 'Croydon' off the St Lawrence-Marlborough road, Sep 1975, *Coveny* 6917 & *Hind* (NSW); Broadsound, St Lawrence, Oct 1873, *Gulliver* (MEL).

Reconstituted or spirit material examined: *Bean* 12264 (2 fls); *Bean* 12267 (2 fls); *Bean* 13764 & *Fox* (2 fls); *Morain* 234 (2 fls).

Distribution and habitat: *S. velleioides* is confined to tropical Queensland, from Mt Surprise to St Lawrence (southernmost record 22° 21'S) (Map 6). It grows along creekbanks and seepage areas, mostly in eucalypt woodland but with one collection from a *Melaleuca leucadendra* forest.

Phenology: Flowers and capsules have been recorded from March to November

Affinities: *S. velleioides* differs from *S. debile* by the paniculate inflorescences, the absence of bracteoles, the longer column and the longer posterior petals. *S. velleioides* differs from *S. paniculatum* by the longer column and the mostly longer capsules. *S. velleioides* has been confused with *S. semipartitum* in the past, but differs from that by its glabrous leaves and scapes.

Conservation status: A widespread species which is not considered to be at risk.

Etymology: The specific epithet refers to the strong resemblence of sterile material to that of *Velleia spathulata.*

22. Stylidium ornatum S.T.Blake, Proc. Roy. Soc. Queensland 73: 76 (1963). **Type:** Queensland. Moreton District: Beerwah, 26°5-'S 152°5-'E, 18 November 1959, *S.T. Blake* 21160 (holo: BRI).

Herbaceous annual or perennial, 10–30 cm high. Glandular hairs 0.1–0.15 mm long; glands capitate. Stems present or absent (with leaves in basal rosette), glabrous. Leaves 5–25 per plant, mostly in terminal rosette, with some scattered below, oblanceolate, 13–37 mm long including petiole, 3–10 mm wide, glabrous, apex obtuse or acute, base cuneate, margins entire. Petioles 3–8 mm long. Scapes 1–2(–4) per plant, 0.7–2 mm in diameter, glabrous. Sterile bracts present. Inflorescences 12–30 cm long including scape, indeterminate, branches monochasially cymose; branches glandular-hairy. Bracts lanceolate or ovate, 1.5–4.5 mm long, glabrous, obtuse or acute. Bracteoles absent. Pedicels 3–6 mm long, glandular-hairy. Hypanthium obovoid to ellipsoidal, glandular-hairy throughout. Sepals lanceolate, all free, 1.1–1.7 mm long, 0.4–0.7 mm wide, glabrous, obtuse or acute. Corolla pink, glabrous; tube 1.1–1.4 mm long, with sinus on anterior and posterior sides. Paracorolla discontinuous, lobed, thin, glabrous, 0.5–0.7 mm high. Paracorolla lobes or appendages 4, all similar, acute, 2 opposite the anterior petals, 2 opposite the posterior petals. Paracorolla glands absent. Labellum attached at base of anterior sinus of corolla tube, lanceolate, 0.8–1.5 mm long, thick or thin, glabrous; terminal appendage present, 0.8–1.5 mm long, acute. Labellum basal appendages absent. Petals all free, A1+A2+P1+P2. Anterior petals 4.1–4.5 mm long, 2.3–2.6 mm wide, entire, acute or obtuse. Posterior petals 3.7–4.2 mm long, 1.5–2.1 mm wide, entire, acute or obtuse. Column 5–6 mm long, of uniform width throughout, glabrous; lateral lobes absent; spur absent. Stigma sessile. Corona absent. Capsule obconical, without raised ribs, 3.3–4 mm long excluding sepals, 1.8–2.4 mm wide; halves detaching distally, not recurved. Seeds ellipsoidal, 0.4–0.5 mm long, brown, lacunose.

Specimens examined: **Queensland.** Wide Bay District: Tin Can Bay, Sep 1946, *Clemens* s.n. (BRI); Fraser Island, Dec 1919, *Epps* 2 (BRI); Cooloola, near Teewah Creek, Sep 1974, *Harrold* C404 (BRI); Fraser Island, Jan 1894, *Lovell* s.n.(BRI); western shore of Lake Boemingen, Fraser Island, Aug 1984, *Walsh* 1401 (BRI, MEL); between Howard and Traverston, Oct 1929, *White* 6375 (BRI). Moreton District: Pine

Ridge Reserve c. 4 miles [6 km] N of Southport, Jan 1968, *Baxter* 1155 (BRI); western edge of Mooloolah River N.P., S of Buderim, May 1997, *Bean* 12015 (BRI); Beerwah, Nov 1960, *Blake* 21434 (BRI, MO, NSW); between Myora and Point Lookout, North Stradbroke Island, Aug 1969, *Coveny* 2029 (BRI, NSW); Moreton Island, 1.4 km ENE of Bulwer, Mar 1973, *Durrington* 330 (BRI); Russell Island, Moreton Bay, undated, *Hauser* s.n. (BRI); 100 metres W of Cinnamon Ave, Coolum Beach, Feb 1982, *Sharpe* 3158 (BRI); 3 km S of Buderim, Apr 1986, *Sharpe* 4327 & *Bean* (BRI); Stradbroke Island, Sep 1915, *White* s.n. (BRI); Maroochydore, Apr 1916, *White* s.n. (BRI). **New South Wales**. North Coast: Wardell, Nov 1893, *Baeuerlen* 1087 (NSW); N of Lake Arragan, Angourie, Feb 1969, *Blaxell* 122 (NSW); c. 1.5 miles [2.4 km] from the coast, just N of Crowdy Head, near Harrington, Jun 1966, *Boyd & McGillivray* 1796 (NSW); Bonny Hills, 16 miles [26 km] S of Port Macquarie, Mar 1970, *Clark* s.n. (NSW); Bombah Pt., Lake Myall, Jan 1952, *Constable* 19058 (NSW); Evans Head, Nov 1972, *Coveny* 4659 (BRI, NSW); South West rocks near oil storage tanks, Apr 1986, *Coveny* 12217 & *Bishop* (BRI, MEL, NSW); Byron Bay, Aug 1915, *Rupp* s.n. (MEL); Smith's Lake, Bungwahl, Mar 1924, *Rupp* s.n. (MEL).

Reconstituted or spirit material examined: *Bean* 12015 (3 fls); *Sharpe* 3158 (1 fl); *Walsh* 1401 (2 fls).

Distribution and habitat: *S. ornatum* extends from Fraser Island in Queensland to the Myall Lakes area in New South Wales (Map 7). It is confined to "wallum" or heathland communities on infertile coastal sands which are waterlogged for much of the year.

Phenology: Flowers and capsules have been recorded from every month of the year

Affinities: *S. ornatum* differs from *S. debile* by the capitate glands (ellipsoidal for *S. debile*), cymose inflorescence (racemose for *S. debile*), the absence of bracteoles (bracteoles present for *S. debile*), the glabrous sepals and corolla (glandular-hairy for *S. debile*), paracorolla present (absent for *S. debile*) and the obconical capsule (ellipsoidal for *S. debile*).

Conservation status: A widespread species which is not considered to be at risk.

Notes: *S. ornatum* was not recognised to occur in New South Wales by Stanberg (1992), but it was by Beadle (1984).

Stylidium sect. **Lanata** A.R.Bean **sect. nov.** Herbae perennes; caulorhiza globosa, lanata; pili glandulosi praesentes; folia rosulata, obovata usque spathulata, mucrone longo piliformi; sepala omnia libera, glandulari-hirsuta; labellum glabrum, ovatum, basi sinus anterioris affixum, appendices praesentes; paracorolla absens; columna glabra; semina sphaerica, colliculata, mamilla parva. **Typus:** *S. eriorhizum* R.Br.

Rootstock globose, woolly. Leaves obovate to spathulate with long hair-like mucro, in basal rosette. Glandular hairs present, glands ellipsoidal. Inflorescence indeterminate; flowers pedicellate; corolla tube with sinus on anterior side only; petals entire and obtuse, laterally fused; labellum attached at base on anterior sinus, basal appendages present. Paracorolla absent. Column lateral lobes absent; spur absent. Anther cells 4. Stigma sessile. Capsule obovoid; seeds globose with small nipple, brown to black.

23. Stylidium eriorhizum R.Br., Prodr. 569 (1810); *Candollea eriorhiza* (R.Br.) F.Muell., Syst. Census Austral. Pl. 86 (1883). **Type:** [Queensland]. Thirsty Sound, Shoalwater Bay, [22°2-'S 150°1-'E], 3 September 1802, *R.Brown* (holo: BM).

See Bean (1999) for description and distribution map.

24. Stylidium ramosissimum A.R.Bean, Austrobaileya 5(2): 323-30 (1999). **Type:** Queensland. Cook District: Turtle Rock area, Laura sandstone escarpment, 15°39'S 144°30'E, 22 January 1993, *P.I. Forster* PIF12850 & *A.R. Bean* (holo: BRI; iso: DNA, MEL).

See Bean (1999) for description, illustration and distribution map.

25. Stylidium leiophyllum A.R.Bean, Austrobaileya 5(2): 323-30 (1999). **Type:** Queensland. Cook District: 0.9 km north of the Big Coleman River on the Peninsula Development road, 14°34'S 143°25'E, 21 December 1988, *J.R. Clarkson* 7722 & *V.J. Neldner* (holo: BRI; iso: DNA, K, MBA, PERTH, QRS).

See Bean (1999) for description, illustration and distribution map.

Acknowledgements

I am grateful to the Directors of AD, BM, DNA, K, MBA, MEL, QRS and NSW for the loan of specimens or access to their Herbaria; to Alex Chapman (Australian Botanical Liaison Officer 1998-99) for his unsuccessful efforts to locate a type for *S. semipartitum*; to Paul Forster for seeking and collecting Stylidia in various parts of Queensland; to Will Smith (BRI) for the illustrations; and to Peter Bostock for the Latin diagnoses.

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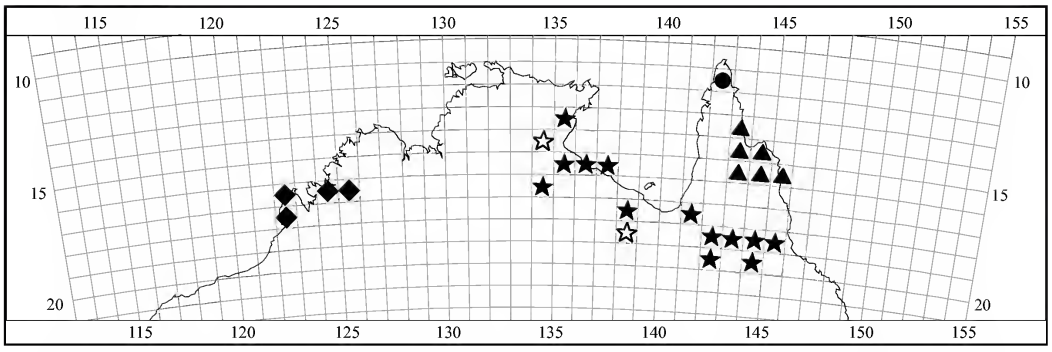
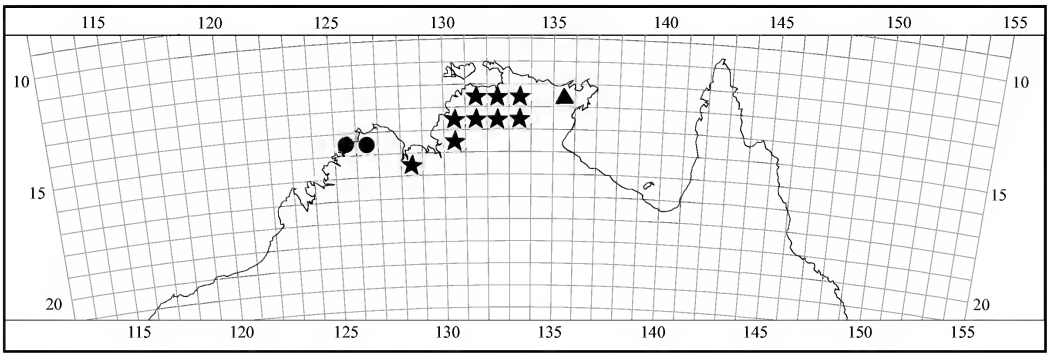
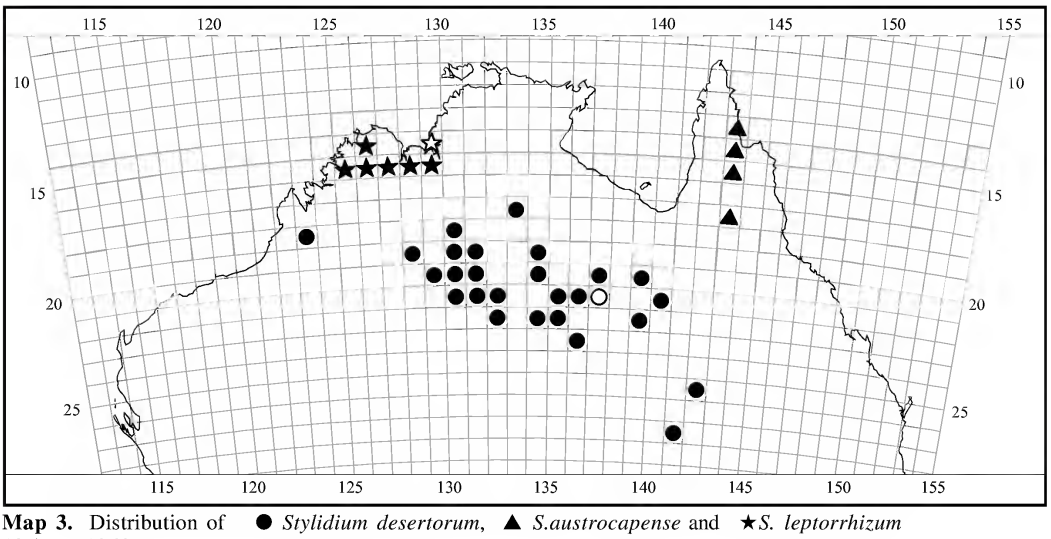


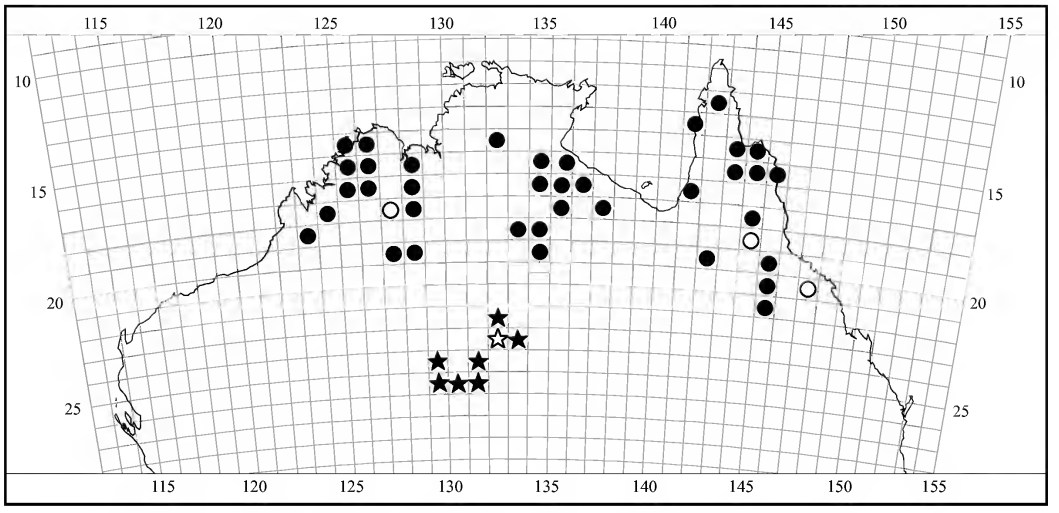
Map 1. Distribution of ● *Stylidium foveolatum*, ▲ *S.clarksonii*, ★*S. costulatum* and *S. floodii* (☆pre-1960).



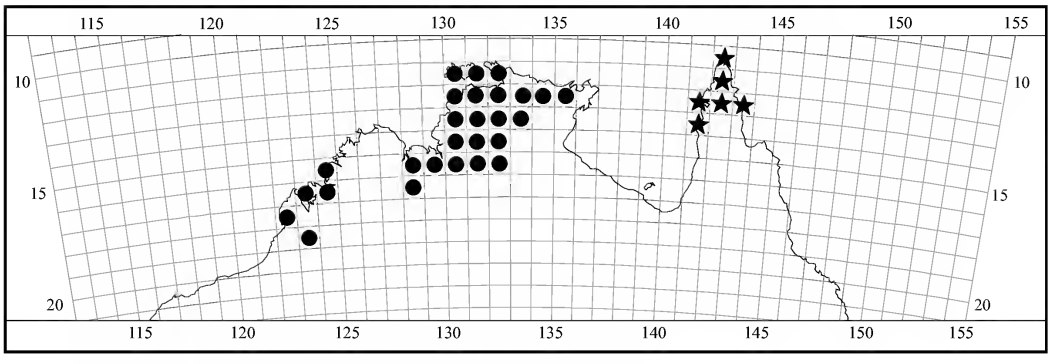
Map 2. Distribution of ★*Stylidium turbinatum*, ● *S.rivulosum* and ▲ *S. symonii*.



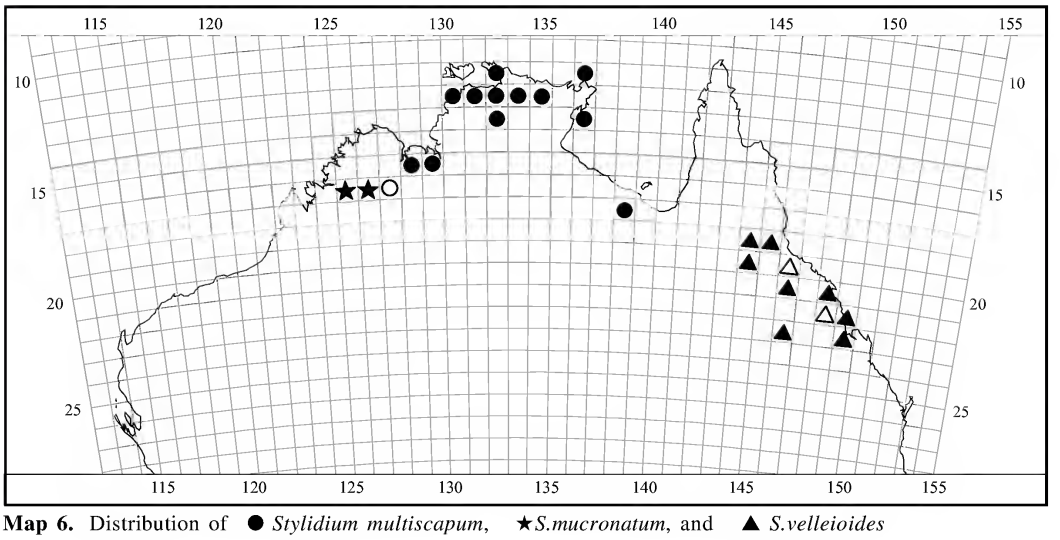
Map 3. Distribution of ● *Stylidium desertorum*, ▲ *S.austrocapense* and ★*S. leptorrhizum* (○☆pre-1960).



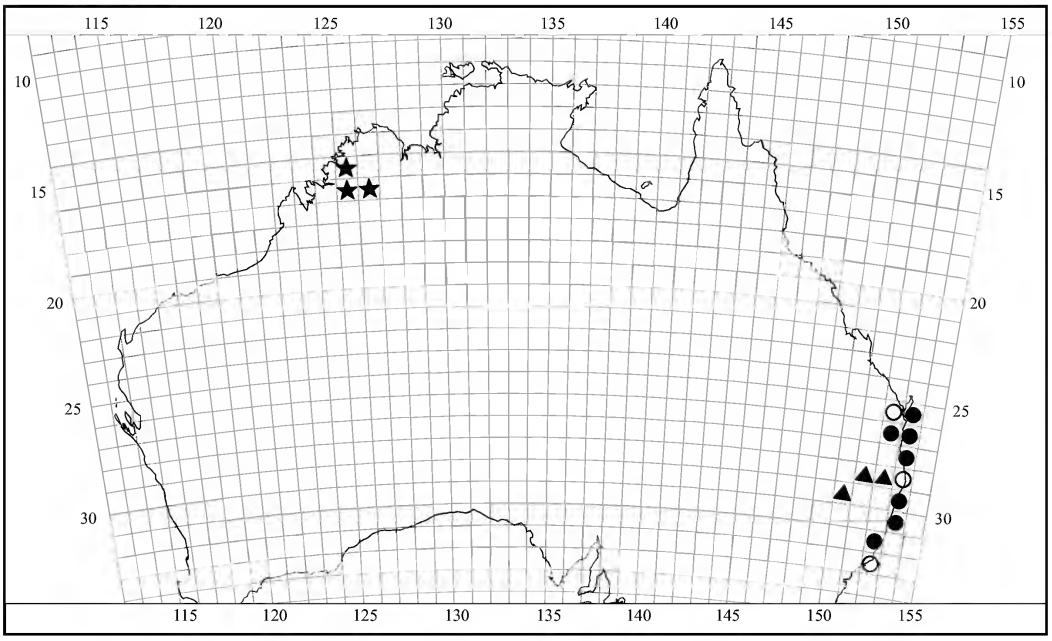
Map 4. Distribution of ● *Stylidium adenophorum*, ★*S.inaequipetalum* (○☆pre-1960).



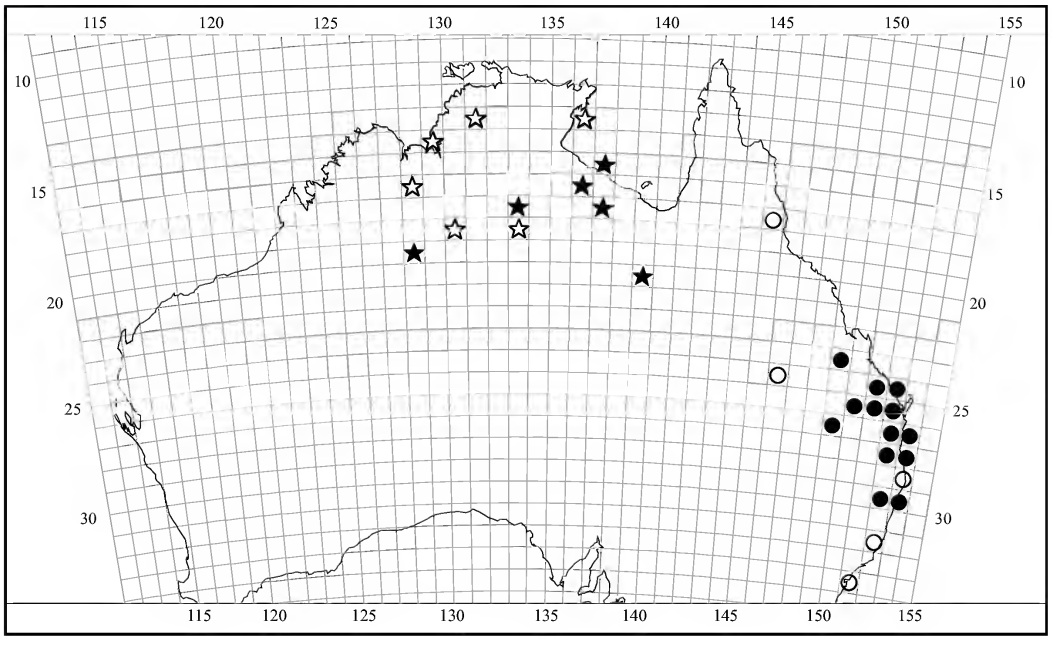
Map 5. Distribution of ● *Stylidium semipartitum*, ★*S.delicatum.*



Map 6. Distribution of ● *Stylidium multiscapum*, ★*S.mucronatum*, and ▲ *S.velleioides* (○△pre-1960).



Map 7. Distribution of ★*Stylidium rubriscapum*, ▲*S.paniculatum* and ● *S.ornatum* (○ pre-1960).



Map 8. Distribution of ● *Stylidium debile*, and ★*S.floribundum* (○☆pre-1960).

A taxonomic revision of *Mallotus* Lour. (Euphorbiaceae) in Australia

Paul I. Forster

Summary

Forster, Paul I. A taxonomic revision of *Mallotus* Lour. (Euphorbiaceae) in Australia. Austrobaileya 5(3): 457-497 (1999). The genus *Mallotus* is revised for Australia. Thirteen species are recognised; *M. claoxyloides* (F.Muell.) Muell.Arg., *M. discolor* F.Muell. ex Benth., *M. dispersus* P.I.Forst. sp. nov., *M. ficifolius* (Baill.) Pax & K.Hoffm., *M. megadontus* P.I.Forst. stat. et nom. nov. (based on *M. claoxyloides* var. *angustifolia* F.M.Bailey), *M.mollissimus* (Geisel.) Airy Shaw, *M. nesophilus* Muell.Arg., *M. paniculatus* (Lam.) Muell.Arg., *M. philippensis* (Lam.) Muell.Arg., *M. polyadenos* F.Muell., *M. repandus* (Willd.) Muell.Arg., *M. resinosus* (Blanco) Merr. and *M. surculosus* P.I.Forst. sp. nov. All taxa are described and the majority illustrated, with notes on distribution, habitat, typification, conservation status and phenology. Lectotypes are selected for *Croton ricinoides* Pers., *Echinus claoxyloides* var. *cordata* Baill., *E. claoxyloides* var. *ficifolia* Baill., *Mallotus nesophilus* and *M. polyadenos*. An identification key to the species is provided.

Key words: *Mallotus, Mallotus dispersus, Mallotus megadontus, Mallotus surculosus.*

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Introduction

Mallotus Lour. has c. 140 species in Malesia, eastern Asia, tropical Africa, Madagascar, Melanesia and Australia (Mabberley 1989). Species are predominantly perennial shrubs or small trees and more rarely woody lianes. Many taxa occur in rainforest, woodland and open forest communities.

The genus was included in the subtribe Rottlerinae Meisn. of the tribe Acalypheae Dumort. in the subfamily Acalyphoideae Ascherson (Webster 1994). Other genera included in this subtribe by Webster are *Coccoceras* Miq., *Cordemoya* Baill., *Deuteromallotus* Pax & K.Hoffm., *Neotrewia* Pax & K.Hoffm., *Octospermum* Airy Shaw, *Trewia* L. and *Rockinghamia* Airy Shaw. None of these other genera except *Rockinghamia* occur in Australia and are not considered further in this account as there is yet to be a satisfactory phylogeny proposed for the group.

The first published Australian record of a plant now referrable to the genus *Mallotus* s.l. was by F. Mueller (1858) who described *Echinocroton claoxyloides* F.Muell. He later (F. Mueller 1864) recorded *Mallotus* for Australia with comments on *M. zippelii* (Hassk.) F.Muell. (a misapplication) and the description of *M. pycnostachys* F.Muell. (a synonym of *M. mollissimus* (Geisel.) Airy Shaw)). J. Mueller (1866) enumerated three species, including the new species *M. nesophilus* Muell.Arg. Bentham (1873) enumerated nine, of which one (*M. angustifolius* Benth.) has since been transferred to *Rockinghamia* Airy Shaw (Airy Shaw 1966).

The most recent account of the genus for Australia is the conspectus and precursor papers of Airy Shaw (1980a, 1980b, 1981) wherein thirteen species were recognised. Despite these recent accounts, a revision of *Mallotus* in Australia is justified for the following reasons. Three of the 'species' detailed by Airy Shaw do not occur in Australia, namely *M. didymochryseus* Airy Shaw, *M. tiliifolius* (Blume) Muell.Arg. and *M. oblongifolius* (Miq.) Muell.Arg. and are based on misidentifications or changes in taxon circumscription. *Mallotus claoxyloides* (F.Muell.) Muell.Arg. as circumscribed by Airy Shaw, is complex and comprises three species, including one which is new. There are an additional two new species from northern

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Australia. Lastly there is a considerable increase in available distributional data over the last 20 years. Hence the present account also covers thirteen species, but with significant differences to those recognised by Airy Shaw (1981).

The genus *Mallotus* may well be polyphyletic, as there is considerable variation in the taxa referred to it, particularly in leaf arrangement, male floral morphology, fruit ornamentation and some anatomical characters (e.g. Hussin *et al.* 1996). A sectional classification exists to take this variation into account (e.g. J. Mueller 1866; cf. Airy Shaw 1971, 1981), but it requires revision as does the genus as a whole. Both of these are beyond the scope of this work but given the numerical size of *Mallotus* s.l. would constitute a worthwhile project for a monograph.

Some species of Australian *Mallotus* are widespread (e.g. *M. nesophilus* and *M. philippensis*), whereas others are quite restricted (e.g. *M. megadontus*). Greatest diversity of the genus can be found in the Iron Range area of Cape York Peninsula followed by parts of the Wet Tropics and south-east Queensland (Map. 1). These concentrations of species are correlated with wetter rainforest occurring in proximity to other community types thereby creating a mosaic of communities.

Little has been recorded about the species of *Mallotus* and how they interact with associated fauna. Floyd (1989) states that the seeds of *M. discolor* have increased germination if gathered from bird droppings. It can be perhaps assumed that all of the various species are dispersed by birds as the fruits are often brightly coloured and with relatively large seeds. The broad distribution of *M. nesophilus* and *M. philippensis* is a reflection of this vagility in the group. With the possible exceptions of *M. dispersus*, *M. megadontus* and *M. resinosus*, the Australian species could be broadly described as pioneers in the seral stages of rainforest succession.

Materials and Methods

This revision is based on herbarium collections in AD, BRI, CANB, CBG, DNA, MEL, NSW, PERTH, PR and QRS, photographs or microfiche of selected collections at BM, C, G, K and P and my own observations and field collections of all taxa. All types have been seen unless indicated as n.v.

Foliage measurements and descriptions have been made from dried material. Flower and fruit descriptions have been made from spirit, reconstituted and dried material. Leaf sizes refer to those measured on fertile stems. Some leaves on juvenile plants may exceed the given measurements. Indumentum cover is as defined by Hewson (1988), except that 'scattered' is used instead of 'isolated'. If a hair or gland type is not mentioned when describing a particular organ, it may be assumed to be absent.

The 'Wet Tropics' is defined as that area of north-eastern Queensland that encompasses the 'hot, humid vine forests' from near Cooktown in the north to Paluma in the south (Webb & Tracey 1981, Barlow & Hyland 1988). Rainforest terminology follows Webb (1978).

Conservation coding terminology follows those used in Queensland Government, Nature Conservation Act legislation (1992, 1994).

The account of species is arranged alphabetically and does not reflect phylogeny.

Taxonomy

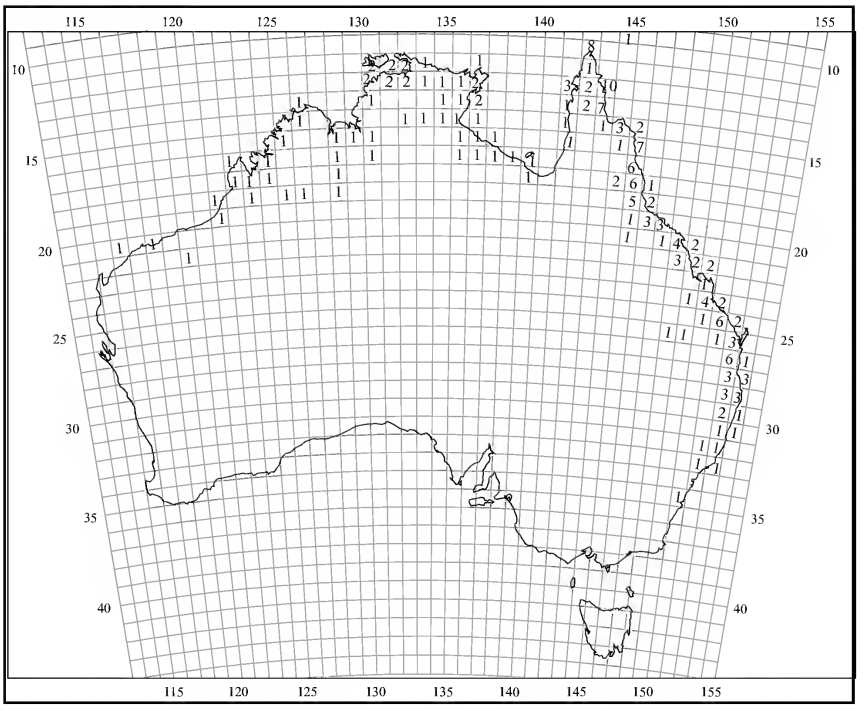
Mallotus Lour., Fl. Cochinch. 601, 635 (1790).
Type: *Mallotus cochinchinensis* Lour.

Echinus Lour., Fl. Cochinch. 601, 633 (1790).
Type: *Echinus trisulcus* Lour.

Rottlera Roxb., Pl. Coromandel 2 (1802).
Type: *Rottlera tinctoria* Roxb.

Echinocroton F.Muell., Fragm. 1: 31 (1858).
Type: *Echinocroton claoxyloides* F.Muell.

Small trees, shrubs or lianes, evergreen or deciduous, monoecious or dioecious, perennial. Indumentum of simple, biseriate or stellate hairs and sessile coloured glands. Leaves opposite or alternate, petiolate, stipulate; lamina lobate or elobate, palminerved or penninerved; margins entire, sinuate or dentate; foliar glands



Map 1. Distribution of ***Mallotus*** in Australia indicating the number of taxa in each 1° grid square.

on upper surface;granular inclusions sometimes present. Inflorescence generally unisexual, spicate, racemose or paniculate, terminal or axillary; male flowers in 1-many flowered bracteate fascicles; female flowers in 1(rarely 2) flowered bracteate fascicles. Male flowers: calyx globose in bud, valvate, 2–4-lobed; petals absent; disk glands absent or present; stamens numerous, filaments free or fused, anthers subdorsifixed, longitudinally dehiscent. Female flowers: calyx ovoid-globose in bud, imbricate to valvate, 2–4-lobed; petals absent; disk glands absent; ovary 2–4-locular, with 1 ovule per locule; styles ±free or connate for varing lengths, simple, generally recurved, papillose or plumose, often with indumentum on backs. Fruit globose to depressed globose, generally strongly angled, smooth or echinate, dehiscing septicidally into bivalved cocci leaving a persisent columella; endocarp crustaceous. Seeds globose to ovoid, ecarunculate; cotyledons broad, flat.

A genus of c. 140 species, widespread in the Old World tropics and subtropics. Thirteen species in Australia.

Key to the Australian species of *Mallotus*

1. Leaves alternate 2
   Leaves opposite 8

2. Leaves peltate 3
   Leaves not peltate 4

3. Plants evergreen; leaves white-silver below, 4-veined from base ..... **6. M. mollissimus**
   Plants deciduous; leaves green below, 6-8-veined from base ..... **13. M. surculosus**

4. Scandent woody lianes ..... **11. M. repandus**
   Shrubs or trees 5

5. Coloured sessile glands not visible or absent from lower leaf surface, indumentum obscuring lower leaf surface ..... **8. M. paniculatus**
Coloured sessile glands on lower leaf surface, indumentum not obscuring lower leaf surface 6

6. Red sessile glands on lower leaf surface ..... **9. M. philippensis**
Yellow sessile glands on lower leaf surface 7

7. Interlateral veins poorly developed below; stamens 24–38 per flower; fruit with yellow to yellow-orange sessile glands ..... **2. M. discolor**
Interlateral veins strongly developed below; stamens 50–60 per flower; fruit with orange sessile glands ..... **7. M. nesophilus**

8. Leaf lamina with granular inclusions above ..... **10. M. polyadenos**
Leaf lamina without granular inclusions above 9

9. Leaf lamina palminerved ..... **3. M. dispersus**
Leaf lamina penninerved 10

10. Leaf lamina without coloured sessile glands below ..... **5. M. megadontus**
Leaf lamina with coloured sessile glands below 11

11. Stems rounded near apices ..... **12. M. resinosus**
Stems flattened near apices 12

12. Stems, leaves and inflorescences with clear stellate hairs when young; leaf lamina margins sinuate, rarely weakly dentate; male flower pedicels thick (0.8–1 mm diameter); male calyx lobes lanceolate to lanceolate-ovate; stamens 46–48 ..... **1. M. claoxyloides**
Stems, leaves and inflorescences with yellow stellate hairs when young; leaf lamina margins strongly dentate with teeth 2–7 mm long; male flower pedicels filiform (0.2–0.3 mm diameter); male calyx lobes obovate; stamens 28–42 ..... **4. M. ficifolius**

1. Mallotus claoxyloides (F.Muell.) Muell.Arg., Linnaea 34: 192 (1865); *Echinocroton claoxyloides* F.Muell., Fragm. 1: 32 (1858); *Echinus claoxyloides* (F.Muell.) Baill., Adansonia 6: 315 (1866). **Type:** Queensland. Moreton District: Brisbane River, [*Hill & Mueller*] [MEL708383] (holo: MEL).

Echinus claoxyloides var. *cordata* Baill., Adansonia 6: 315 (1866); *Mallotus claoxyloides* var. *cordatus* (Baill.) Airy Shaw, Muelleria 4: 232 (1980). **Type:** New South Wales. Richmond River [*Beckler*] [MEL515956] (lecto [here designated]: MEL).

Mallotus claoxyloides var. *glabratus* Domin, Biblioth. Bot. 28: 888 [334] (1928). **Type:** Queensland. South Kennedy District: Port Mackay, 1863-1865, *A. Dietrich* 524 (holo: PR; iso: CANB, MEL).

***Illustrations*:** Williams (1984: 189, 1987: 197); Floyd (1989: 151); Hauser (1992: 264).

Shrub or small tree to 5 m high; evergreen, perennial, dioecious. Stems ± flattened towards apices, with dense, clear stellate hairs when young, glabrescent and lenticellate with age. Stipules linear-lanceolate, 1.7–7 mm long, 0.3–1 mm wide, with sparse, clear stellate hairs. Leaves opposite, not peltate, petiolate, discolorous; petioles 4–23 mm long, 0.6–0.7 mm

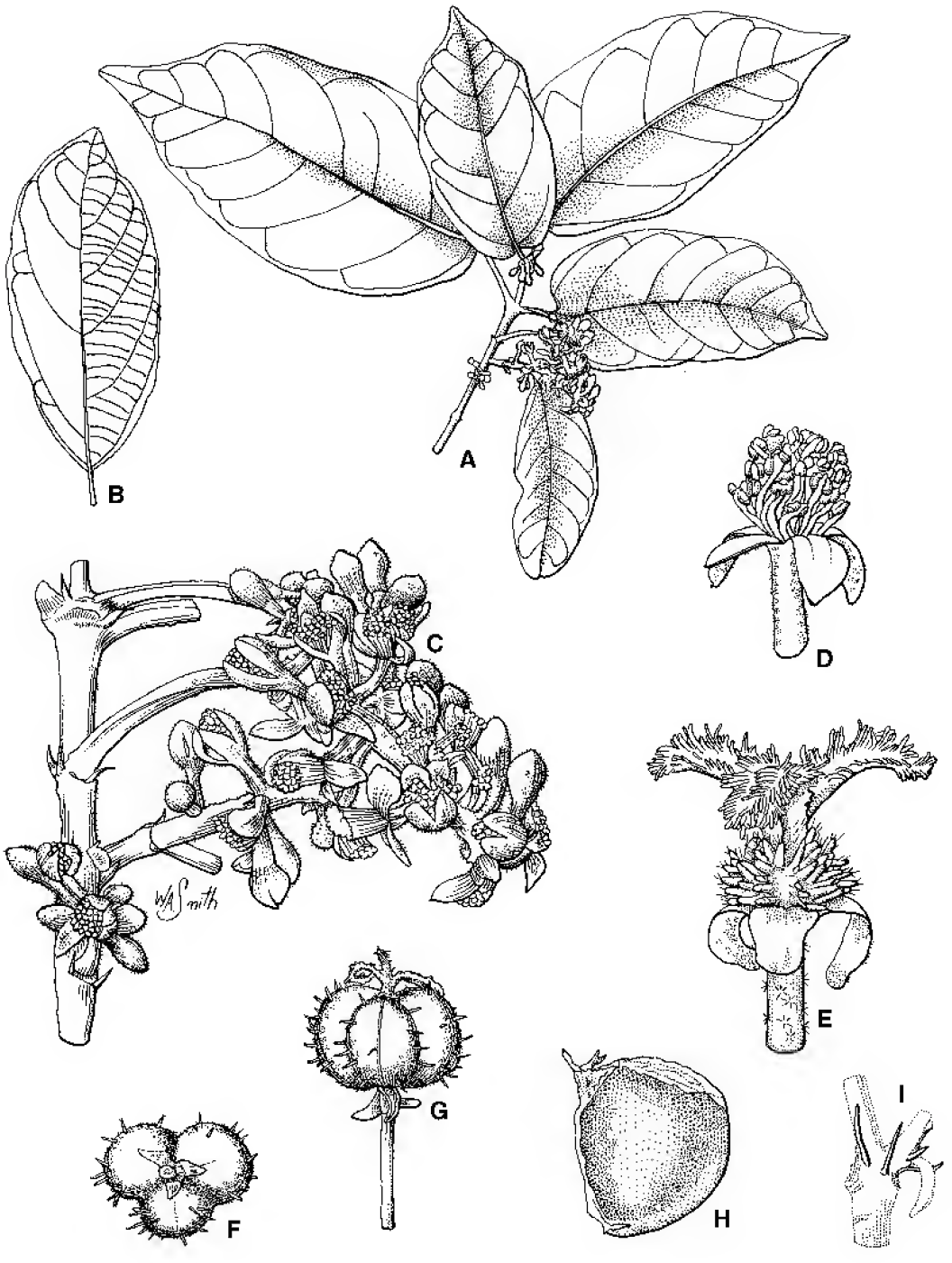


Fig. 1. ***Mallotus claoxyloides***. A. flowering twig. x 0.5. B. undersurface of leaf. x 0.5. C. twig with several inflorescences of male flowers. x 2. D. male flower. x 5. E. female flower. x 5. F & G. fruit. x 2. H. seed. x 4. I. internode with stipules emphasized. x 2. A-D from *Forster* 2744 (BRI); E from *Forster* 12437 (BRI); F & G from *Forster* 520 (BRI); H & I from *White* 8697 (BRI). Del. W.Smith.

diameter, with scattered to sparse, clear stellate hairs; basilaminar glands 1 per side of midrib towards lamina base, ellipsoid, 0.5–1 mm long, 0.4–0.6 mm wide; lamina elliptic, oblong or obovate, 35–170 mm long, 20–80 mm wide; penninerved, comprising 6–9 lateral veins per side of midrib and reticulate interlateral veins; upper surface ±glossy mid-green, lateral veins visible, interlateral veins not visible, without granular inclusions, with scattered to sparse, clear stellate hairs, glabrescent; lower surface pale green, lateral and interlateral venation well developed, with dense, clear stellate hairs and scattered, yellow sessile glands, becoming glabrescent with age; tip acute, acuminate or rounded; base cordate or rounded; margins sinuate or weakly dentate with 8–15 teeth up to 4 mm long, strongly toothed on juvenile foliage. Inflorescences racemose, up to 25 mm long, with sparse, clear stellate hairs; bracts lanceolate, 1–2 mm long, 0.5–1 mm wide, with scattered to sparse, clear stellate hairs. Male flowers 2–5 per bract; pedicels 1–4 mm long, 0.2–0.3 mm diameter, glabrous or with scattered to sparse, clear stellate hairs; calyx 3-lobed, lobes lanceolate to lanceolate-ovate, 3-5 mm long, 1.5–3 mm long, with sparse, clear stellate hairs; disk glands absent; stamens 46–48, free; filaments filiform, 1.5–4 mm long, 0.1–0.2 mm diameter, glabrous; anthers oblong, 0.4–0.5 mm long, 0.4–0.5 mm wide, glandular cap absent. Female flowers 1 or 2 per bract; pedicels 6–25 mm long, 0.5–1 mm diameter, with sparse, clear stellate hairs; calyx 3-lobed, lobes lanceolate, 2.5–4 mm long, 1–2 mm wide, with sparse, clear stellate hairs and scattered yellow sessile glands; ovary 3-locular, subglobose, 2–2.5 mm long, 2.5–4 mm diameter, with scattered, clear stellate hairs and simple echinate processes to 1 mm long that have a few clear stellate hairs; styles 3, 3–7 mm long, connate at base for c. 1 mm, plumose with sparse, clear stellate hairs on backs. Fruits subglobose, 6–8 mm long, 11–13 mm diameter, with scattered, clear stellate hairs and simple, echinate processes to 1 mm long with scattered, clear stellate hairs. Seeds ovoid, 5–5.5 mm long, 4.5–5 mm wide, 4–4.5 mm thick, smooth, brown. *Odour bush, Green kamala, Smell of the bush.* Fig. 1.

***Selected additional specimens*: Queensland.** COOK DISTRICT: Muddy Bay, Cape York, 10°43'S, 142°33'E, Jun 1994, *Forster* PIF15327 & *Tucker* (BRI, QRS); Hill 334, Pascoe River, 12°52'S, 143°01'E, Jun 1994, *Forster* PIF15386 & *Tucker* (BRI, MEL, QRS); Kalpowar Holding, 17°25'S, 144°20'E, Sep 1970, *Hyland* 4795 (BRI, QRS). SOUTH KENNEDY DISTRICT: St Bees Island, Turtle Bay, 36 km NE of Mackay, 20°55'S, 149°27'E, Mar 1989, *Batianoff* 11019 (AD, BRI). LEICHHARDT DISTRICT: Boomer Range, 23°13'S, 149°46'E, Feb 1993, *Fensham* 699 (BRI). PORT CURTIS DISTRICT: 2.5 km SW of Raglan, R146, Horrigan Creek, 23°43'S, 150°48'E, Mar 1989, *Gibson* TOI486 (BRI). BURNETT DISTRICT: Mt Blandy, 25°24'S, 151°45'E, Dec 1980, *Forster* PIF520 (BRI); Kalliwa Creek, S.F. 169 St Agnes, 25°19'S, 151°51'E, Dec 1990, *Forster* PIF7718 (BRI, K, L, MEL, MO, NSW, QRS); Cannindah, c. 20 km NE of Monto, May 1975, *Romano* [AQ203712] (BRI). WIDE BAY DISTRICT: Mt Woowonga, S.F. 287, 25°26'S, 152°06'E, Oct 1990, *Forster* PIF7538 (BRI, K, L, MEL, QRS); S.F. 82 Brooyar, Dry L.A., 26°11'S, 152°28'E, Dec 1991, *Forster* PIF9262 & *Tucker* (BRI, K, L, MEL, QRS); NW slopes of Mt Glastonbury, 26°14'S, 152°27'E, Dec 1991, *Forster* PIF9309 & *Sharpe* (BRI, K, L, MEL, QRS); road from Wallaville to Mingo Crossing, c. 4 miles [6.7 km] SW of Wallaville, 25°06'S, 151°48'E, Jan 1970, *Lebler* 11 & *Durrington* (BRI, CANB); Tinana Creek, 7 km ENE of Tiaro, 25°42'S, 152°39'E, Jan 1992, *Smyrell* [AQ541631] (BRI). MORETON DISTRICT: Two Tree Hill, 3 km SW of Marburg, 27°35'S, 152°33'E, Jan 1993, *Bird* [AQ563800] (BRI, L, MEL, QRS); 6 km W of Woombye, 26°38'S, 152°53'E, Dec 1992, *Forster* PIF12436 & *Sharpe* (BRI, MEL, QRS); Upper Brookfield, Brisbane, Feb 1978, *Jessup* 45 (BRI); Mt Eerwah, 4 km W of Eumundi, 26°29'S, 152°55'E, Jan 1985, *Sharpe* 3681 (BRI). **New South Wales.** Wilson Park, Lismore, 28°49'S, 153°16'E, Jul 1981, *Harden* 81269 & *Williams* (BRI); Toonumbar, near Kyogle, Mar 1944, *White* 12570 (BRI).

***Distribution and habitat*:** *Mallotus claoxyloides* is widespread in subcoastal areas with a more or less continuous distribution from north-east New South Wales to the South Kennedy district of Queensland and with a couple of disjunct occurrences in Cook district (Map 3). This species is also reported for southern New Guinea (Airy Shaw 1980c).

Mallotus claoxyloides is a common plant on the edges of semi-evergreen vinethicket, araucarian microphyll and notophyll vineforests on a variety of substrates and is common along creeks. The foliage may emit a distinctive 'scrub' scent that is noticeable to some people in proximity to the plants.

***Phenology*:** Flowers from October to April; fruits from November to May.

***Notes*:** Airy Shaw (1981) included *Mallotus claoxyloides* var. *macrophylla* in the synonymy of *Mallotus claoxyloides* var. *cordatus*. In the present account *Mallotus claoxyloides* var. *macrophylla* is included in the synonymy of *M. ficifolius* and *M. claoxyloides* var. *cordatus* is included in the synonymy of *M. claoxyloides*. I believe it unlikely that Airy Shaw saw many of the syntypes of *Echinus claoxyloides* var. *cordatus*, otherwise he would not have considered it and *M. claoxyloides* var. *macrophylla* as the same. All of the syntypes that I have seen of *M. claoxyloides* var. *cordatus* are conspecific with the type of the name *Echinocroton claoxyloides* and a lectotype is designated here from the Richmond River specimen.

***Conservation status*:** *Mallotus claoxyloides* is a common plant and is well conserved, occurring in at least 23 conservation reserves in south-east Queensland alone (Forster *et al.* 1991).

***Etymology*:** The specific epithet alludes to the superficial similiarity of this plant to species of the Euphorbiaceous genus *Claoxylon*.

***Uses*:** Suitable for wood turning and inlay work (Floyd 1989).

2. Mallotus discolor F.Muell. ex Benth., Fl. Austral. 6: 173 (1873). **Type:** New South Wales. Clarence River, *London Exhibition* 82 (holo: K n.v. [photo at BRI]).

***Illustrations*:** Williams (1979: 185, 1987: 199); Floyd (1989: 151); Hauser (1992: 101).

Shrub or small tree to 15 m high; evergreen, perennial, dioecious. Stems ± rounded, with dense silky, clear, simple or biseriate hairs and scattered yellow sessile glands when young, glabrescent. Stipules apparently absent. Leaves alternate, not peltate, petiolate, discolorous; petioles 3–40 mm long, 0.4–0.7 mm diameter, with dense, clear simple, biseriate or stellate (or combination thereof) hairs; basilaminar glands 1 per side of midrib towards lamina base, ellipsoid, 0.3–0.4 mm long, 0.2–0.3 mm wide; lamina lanceolate-ovate, obovate or ovate, 10–110 mm long, 5–70 mm wide; palminerved, comprising 2 veins from the lamina base, 5–8 lateral veins per side of midrib and reticulate interlateral veins; upper surface glossy dark-green, lateral and interlateral veins barely visible, without granular inclusions, with dense clear, simple, biseriate and/or stellate hairs when young, soon becoming scattered with age; lower surface pale green to silver-green, lateral venation well developed, interlateral veins just visible, with dense, clear, simple, biseriate and/or stellate hairs and sparse yellow sessile glands, indumentum persistent; tip acute, short acuminate; base cuneate, rounded or truncate; margins entire or weakly sinuate. Inflorescences racemose, up to 70 mm long, with dense, clear stellate hairs; bracts lanceolate-triangular, 0.3–0.7 mm long, 0.3–0.4 mm wide, with dense clear stellate hairs. Male flowers 1- 5 per bract; pedicels 0.6–2 mm long, 0.5–0.6 mm diameter, with dense clear, stellate hairs; calyx 2 or 3-lobed, lobes lanceolate-ovate, often unequal, 1.6-2.2 mm long, 1.4–1.6 mm long, with dense, clear stellate hairs and occasional yellow sessile glands; disk glands absent; stamens 24–38; filaments fused at base for up to 0.2 mm, 0.4–0.5 mm long, c. 0.1 mm diameter, glabrous; anthers oblong, 0.4–0.5 mm long, 0.4–0.5 mm wide, glabrous, with a yellow glandular cap. Female flowers 1 per bract; pedicels 0.7–1 mm long, 0.5–0.7 mm diameter, with dense, clear stellate hairs; calyx 3 or 4-lobed, lobes lanceolate-ovate, 1.6–2 mm long, 0.6–1.2 mm wide, with dense, clear stellate hairs; ovary 3–4 locular, subglobose, 1.8–2 mm long, 1.1–2.5 mm diameter, with dense yellow sessile glands, echinate processes absent. Styles 3(4), 1.2–2.3 mm long, connate at base for 0.3–0.4 mm, plumose, glabrous on backs. Fruits subglobose, 5–8 mm long, 7–10 mm diameter, with dense, yellow to yellow-orange sessile glands, echinate processes absent. Seeds ovoid, 3.5–4 mm long, 3.5–4 mm wide, 3.4–3.6 mm thick, tan-brown. *Yellow kamala*. Fig. 2.

***Selected additional specimens*: Queensland.** Port Curtis District: Farnborough Beach, 4 km N of Yeppoon, 23°06'S, 150°45'E, Sep 1977, *Batianoff* 532 & *McDonald* (BRI); Keppel Sands, 23°20'S, 150°48'E, *Batianoff* 9304 & *Dillewaard* (BRI); Tannum Sands, 23°57'S, 151°22'E, Nov 1987, *Batianoff* 9317 & *Dillewaard* (BRI); Long Beach, Great Keppel Island, 23°11'S, 150°56'E, Nov 1987, *Batianoff* 9747 & *Dillewaard* (BRI); Colosseum Creek, 2 km along forestry road off Blackmans Gap road,

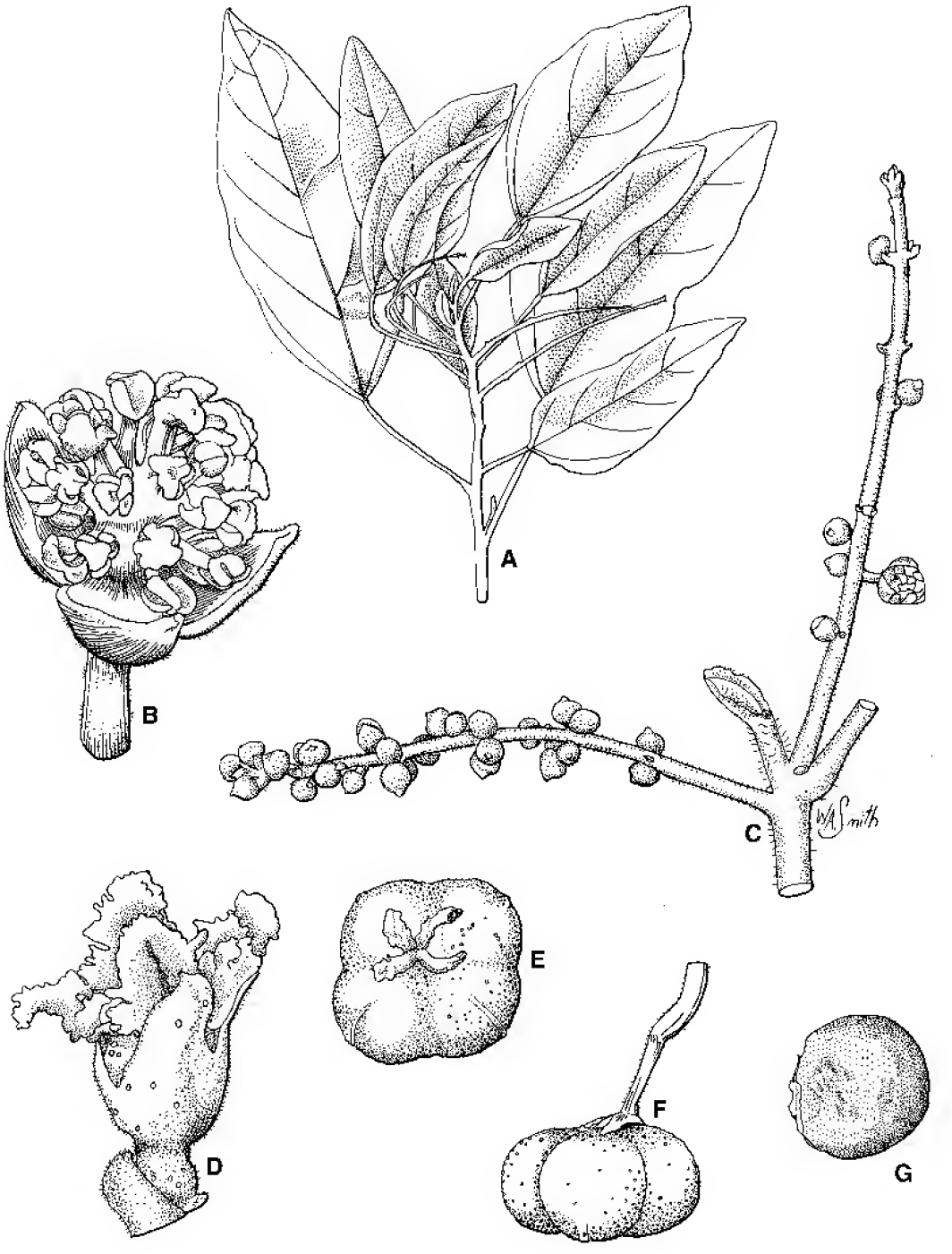


Fig. 2. ***Mallotus discolor***. A. twig. x 0.6. B. male flower. x 12. C. inflorescence. x 3. D. female flower. x 12. E & F. fruit. x 4. G. seed. x 6. A from *Forster* 2744 (BRI); B & C from *Forster* 14276 (BRI); D from *Smyrell* AQ541630 (BRI); E-G from *Forster* 9165 (BRI). Del. W. Smith.

24°24'S, 151°28'E, Dec 1993, *Forster* PIF14276 (A, BRI, L, MEL, QRS); Portion 6V, Castletower, 24°09'S, 151°16'E, Dec 1987, *Gibson* 1032 (BRI); Deepwater N.P., 40 km E of Miriam Vale, 24°19'E, 151°58'E, Oct 1989, *Gibson* TOI873 (BRI). Wide Bay District: Sugarbag Creek, 8 km SSW of Pialba, 25°24'S, 152°32'E, Jan 1987, *Forster* PIF2826 (BRI, MEL); Ocean Park Estate, Dundowran, Nov 1991, *Forster* PIF9165 & *Smyrell* (A, AD, BRI, CANB, CBG, K, L, MEL, MO, NSW, NY, PERTH, QRS); Fairlies Knob area, 25°29'S, 152°17'E, Dec 1992, *Forster* PIF12572 & *Smyrell* (BRI); The Hummock near Bundaberg, Dec 1938, *Goy* 627 & *Smith* (BRI); Tinana Creek, 7 km ENE of Tiaro, 25°42'S, 152°39'E, Jan 1992, *Smyrell* [AQ541630] (BRI). Moreton District: Goat Island, c. 1 km W of Dunwich on Stradbroke Island, 27°31'S, 153°24'E, Nov 1973, *Sharpe* 867 & *Durrington* (BRI); Coolum Beach, Dec 1978, *Sharpe* 2472 (BRI); Mt Eerwah, 4 km W of Eumundi, 26°29'S, 152°55'E, Jan 1985, *Sharpe* 3676 (BRI, MEL); Mt Glorious, May 1920, *White* [AQ203755] (BRI); World's End Pocket, Pine Mt, c. 11 km N of Ipswich, 27°36'S, 152°45'E, Dec 1983, *Williams* 83075 (BRI). **New South Wales.** Bexhill, Jan 1895, *Baker* [MEL708513] (MEL).

***Distribution and habitat*:** *Mallotus discolor* occurs in the Port Curtis, Wide Bay and Moreton districts in Queensland and the extreme north-east of New South Wales (Map 2). Plants grow in araucarian microphyll vineforest and littoral vineforest on a variety of substrates, but generally on sandy or alluvial soils.

***Phenology*:** Flowers October to January; fruits November to April.

***Notes*:** Airy Shaw considered that *Mallotus discolor* had a northern limit in the North Kennedy district; however, these records pertain to *M. nesophilus*. *Mallotus discolor* and *M. nesophilus* are superficially similar plants but may be easily distinguished by a number of vegetative and floral characters. The former has indistinct interlateral veins in the lower leaf lamina surface, male flowers with lanceolate-ovate sepals and 24–38 stamens, and the fruit with yellow to yellow-orange sessile glands, whereas the latter has well developed interlateral veins in the lower leaf surface, male flowers with obovate sepals and 50–60 stamens and the fruit with orange sessile glands.

***Conservation status*:** *Mallotus discolor* is a common plant and is well conserved occurring in at least 7 conservation reserves in south-east Queensland (Forster *et al.* 1991).

***Etymology*:** The specific name is from Latin and alludes to the *discolorous* nature of the leaf lamina in this species.

***Uses*:** None recorded.

3. Mallotus dispersus P.I.Forst., **sp. nov.** affinis *M. didymochryseo* Airy Shaw a qua in habitu frutice deciduo usque 2–5 m alto; lamina foliorum plerumque glandibus abaxialibus flavis sessilibus; inflorescentia masculina 50–100 mm longa pedunculo 0.5–1.2 mm diametro; pedicellis florum masculinorum 1.5–3.5 mm longis, et femineorum 3-5 mm longis et 0.8–1 mm diametro; et stylis 3.5–5 mm longis differt. **Typus:** Queensland. Cook District: Muddy Bay, Cape York, 10°43'S, 142°33'E, 25 Jun 1994, *P.I. Forster* PIF15304 & *M.C. Tucker* (holo: BRI [2 sheets + spirit]; iso: A, BISH, CANB, DNA, K, L, MEL, NSW, QRS).

[*Mallotus didymochryseus* auct., non Airy Shaw; Airy Shaw (1981); Hyland & Whiffin (1993)]

***Illustration*:** Christophel & Hyland (1993: 108, t. 46A).

Shrub 2–5 m high; seasonally deciduous, perennial, dioecious. Stems ± rounded towards apices, with dense, yellow stellate hairs when young, glabrescent and lenticellate with age. Stipules acuminate-lanceolate, 0.8–1 mm long, 0.7–0.8 mm wide, with sparse, silver to yellow stellate hairs. Leaves opposite, not peltate, petiolate, discolorous; petioles 16–90 mm long, 1–2 mm diameter, with dense, silver to yellow stellate hairs; basilaminar glands 1–6 per side of midrib near lamina base, ellipsoid, 0.4–0.8 mm long, 0.3–0.5 mm wide; lamina broad-ovate, elliptic-ovate, 25–150 mm long, 20–140 mm wide; palminerved, comprising 5–7 veins from lamina base, 4–5 lateral veins per side of midrib and reticulate interlateral veins; upper surface glossy dark-green, lateral veins visible, without granular inclusions, with dense, silver to yellow stellate hairs when young becoming scattered or sparse with age; lower surface pale green,

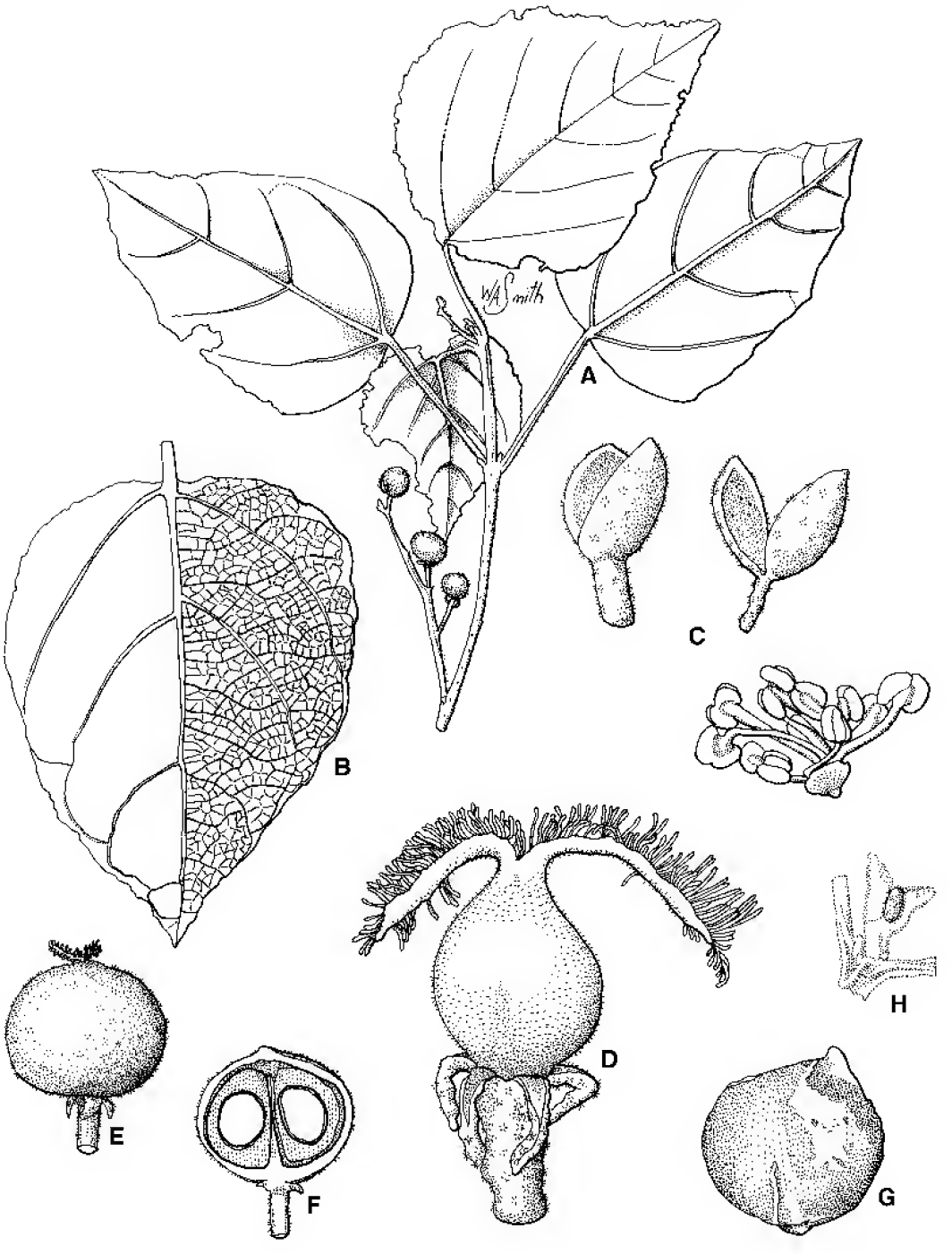


Fig. 3. ***Mallotus dispersus***. A. fruiting twig. x 0.5. B. undersurface of leaf. x 1. C. male flower and sepals. x 5. D. female flower. x 5. E. fruit from side. x 2. F. cross-section of fruit. x 2. G. seed. x 4. H. node with stipule highlighted. x 2. A, B, E-G from *Forster* 15304 (BRI); C & H from *Russell-Smith* 4675 (BRI); D from *Hyland* 13808 (QRS). Del. W. Smith.

lateral and interlateral venation well developed, velutinous with dense, silver to pale brown stellate hairs and sparse, pale-yellow sessile glands; tip acute, short acuminate; base cordate or rounded; margins sinuate or weakly dentate with 12–18 teeth up to 1 mm long. Inflorescences racemose, up to 100 mm long, with dense, ginger stellate hairs; bracts lanceolate to triangular, 1–1.5 mm long, 0.3–1.5 mm wide, with dense, silver to yellow stellate hairs. Male flowers 1–3 per bract; pedicels 1.5–3.5 mm long, 0.8–1 mm diameter, with dense yellow or silver stellate hairs; calyx 4-lobed, lobes narrow obovate, 3–3.5 mm long, 1.8–3 mm long, with dense ginger or yellow stellate hairs; disk glands absent; stamens 62–78, free; filaments filiform, 0.6–2.5 mm long, c. 0.1 mm diameter, glabrous; anthers oblong, 0.5–0.7 mm long, 0.5–0.7 mm wide, with an occasional stellate hair, glandular cap absent. Female flowers 1 per bract; pedicels 3–5 mm long, 0.8–1mm diameter, with dense, ginger and/or yellow stellate hairs; calyx 4-lobed, lobes lanceolate, 3–5 mm long, c. 1 mm wide, with dense ginger and/or yellow stellate hairs; ovary 2-locular, ± ovoid, 3.5–7 mm long, 4–6 mm diameter, with dense yellow stellate hairs and dense yellow sessile glands, without echinate processes; styles 2, 3.5–5 mm long, connate at base for 0.5–1 mm, plumose with dense, silver to yellow stellate hairs on backs. Fruits flattened subglobose, 8–12 mm long, 13–18 mm diameter, with dense, orange-yellow simple-stellate hairs and dense, glandular-based stellate hairs, echinate processes absent. Seeds ovoid, 5–7 mm long, 5–6 mm wide, 4.5–5 mm thick, tan-brown. Fig. 3.

***Selected additional specimens*: Western Australia.** Mitchell Plateau, 14°52'S, 125°50'E, Apr 1988, *Dunlop* 7873 (DNA, MEL, PERTH); Bougainville Peninsula, 2 km SW of August Point, Vansittart Bay, 14°05'S, 126°11'E, May 1984, *Forbes* 2191 (BRI, CANB, DNA, MEL, PERTH); Prince Frederick Harbour, 15°00'S, 125°21'E, Jan 1989, *Hyland* 13808 (QRS), 13809 (QRS); 4.6 km NNE Savage Hill, Bigge Island,14°35'S, 125°11'E, Jun 1987, *Kenneally* 10165 & *Hyland* (DNA, PERTH); 10 km NW of September Point, near Cape Bougainville, 14°04'S, 126°08'E, Jun 1987, *Kenneally* 10219 & *Hyland* (PERTH); 3.4 km SW of Manning Peak, Prince Frederick Harbour, Jun 1987, *Kenneally* 10275 & *Hyland* (PERTH, QRS); South West Osborne Island, North Kimberley coast, 14°22'S, 125°57'E, Jun 1988, *Kenneally* 10744 & *Hyland* (BRI, CANB, DNA, PERTH); 3.4 km SW of Manning Peak by Prince Frederick Harbour, 15°00'S, 125°21'E, Jan 1989, *Kenneally* 10841 & *Hyland* (BRI, DNA, PERTH); Osborne Island, SW island, Bonaparte Archipelago, 14°26'S, 125°56'E, Jun 1973, *Wilson* 11045 (PERTH). **Northern Territory.** Groote Eylandt, Umbakumba, 4 Mile Jungle, 13°52'S, 136°47'E, Jul 1987, *Russell-Smith* 2743 & *Lucas* (BRI, CANB, DNA); ditto, *Russell-Smith* 2971 & *Lucas* (BRI, DNA); Gove Peninsula, 2 km NE of Port Bradshaw, 12°27'S, 136°49'E, Sep 1987, *Russell-Smith* 3389 & *Lucas* (BRI, DNA); 0.5 km W of Little Bondi, Gove Peninsula, 12°18'S, 136°56'E, Feb 1988, *Russell-Smith* 4715 & *Lucas* (BRI, CANB, DNA); Dalywoi Bay, Gove, 12°23'S, 136°53'E, Feb 1988, *Russell-Smith* 4935 & *Lucas* (BRI, DNA); Holly Inlet, Port Bradshaw, NE Arnhem Land, 12°36'E, 136°42'E, Feb 1988, *Russell-Smith* 4941 & *Lucas* (BRI, DNA); Bagbiringula Point, NE Arnhem Land,13°09'S, 136°31'E, Feb 1988, *Russell-Smith* 4977 & *Lucas* (BRI, DNA); NE Arnhem Land, Guyuwiri Point, 13°01'S, 136°35'E, Feb 1988, *Russell-Smith* 4999 & *Lucas* (BRI, DNA); Yirrikala, E Arnhem Land, 12°13'S, 136°54'E, Jan 1974, *Scarlett* 300 (DNA); Little Lagoon, Groote Eylandt, May 1948, *Specht* 437 (AD, BRI, MEL). **Queensland.** Big Creek, Prince of Wales Island, Torres Strait, 10°45'S, 142°15'E, Feb 1975, *Cameron* 20315 (QRS).

***Distribution and habitat*:** *Mallotus dispersus* is restricted to northern Australia and is disjunct in its distribution with populations at the Gove Peninsula and Groote Eylandt in the Northern Territory, the Kimberley of Western Australian and Torres Strait and the northern extremity of Cape York Peninsula in Queensland (Map 6). Plants grow in semi-deciduous notophyll vineforest and vinethickets on sand-dunes behind the foreshore.

***Phenology*:** Flowers January to February; fruits January to September.

***Notes*:** The only Australian collection (*Specht* 437) of this species seen by Airy Shaw was identified as *Mallotus didymochryseus* Airy Shaw (1981). He commented that "The leaves of this specimen are less than 10 cm in diameter", undoubtedly in comparison to the considerably larger leaves of collections of authentic *M. didymochryseus* from Papua New Guinea. *M. didymochryseus* is based on a collection from Central Province in southern Papua New Guinea and occurs in evergreen rainforests on deep soils as an evergreen, small tree 10–20 m high. By comparison the superficially similar Australian plant occurs in semi-decidous notophyll vineforest and

vinethickets on sand-dunes behind the foreshore and is a seasonally deciduous shrub, 2–5 m high. *M. didymochryseus* has leaf laminas without yellow sessile glands below; male inflorescences 120–210 mm long on peduncles 1.8–2 mm diameter; male flower pedicels 3.5–4 mm long; female flower pedicels 5–8 mm long, 1.4–1.5 mm diameter; styles 2.5–3.2 mm long, whereas *M. dispersus* has leaf laminas generally with yellow sessile glands below; male inflorescences 50–100 mm long on peduncles 0.5–1.2 mm diameter; male flower pedicels 1.5–3.5 mm long; female pedicels 3–5 mm long, 0.8–1 mm diameter and styles 3.5–5 mm long.

***Etymology*:** The specific name is derived from the Latin *dispersus* and refers to the dispersed nature of the known populations of this plant.

***Uses*:** None recorded.

***Conservation status*:** Uncommon, but not considered rare or threatened at this stage.

4. Mallotus ficifolius (Baill.) Pax & K.Hoffm. in Engl. & Prantl., Natur. Pflanzenf. 7: 151 (1914); *Echinus claoxyloides* var. *ficifolia* Baill., Adansonia 6: 315 (1866); *M. claoxyloides* var. *ficifolius* (Baill.) Benth., Fl. Austral. 6: 141 (1873). **Type:** Queensland. PORT CURTIS DISTRICT: Rockhampton, 24 Dec 1862, *Dallachy* 47 (lecto [here designated]: MEL [MEL515951]).

Mallotus claoxyloides f. *grossedentata* Domin, Biblioth. Bot. 89: 888 (1928). **Type:** Queensland. SOUTH KENNEDY DISTRICT: "Prope Brisbane River" [probably actually Port Mackay], 1863-1865, *A. Dietrich* 1834 (holo: PR; iso: MEL).

Mallotus claoxyloides var. *macrophylla* Benth., Fl. Austral. 6: 141 (1873). **Type:** Queensland. COOK DISTRICT: Rockingham Bay, *Dallachy* (holo: K n.v. [photo at BRI]; iso: MEL [MEL708581, 708574, 232382]).

Shrub or small tree to 6 m high; evergreen, perennial, usually dioecious but occasionally monoecious. Stems flattened towards apices, with dense, velutinous, yellow, stellate hairs when young, becoming sparse with age. Stipules linear-lanceolate, 4–10 mm long, 0.5–1 mm wide, with dense, yellow stellate hairs. Leaves opposite, not peltate, petiolate, discolorous; petioles 7–80 mm long, 1–2 mm diameter, with dense, yellow stellate hairs; basilaminar glands 2 or 4 per side of midrib towards lamina base, ellipsoid to oblong, 1.2–1.6 mm long, 0.6–0.8 mm wide; lamina elliptic, lanceolate-ovate, obovate or ± orbicular, 50–250 mm long, 22–250 mm wide; penninerved, comprising 6-8 lateral veins per side of midrib and reticulate interlateral veins; upper surface dull green, lateral veins barely visible, without granular inclusions, with sparse velutinous, yellow stellate hairs becoming scattered with age; lower surface pale green, lateral and interlateral venation well developed, with dense velutinous, yellow, stellate hairs and scattered, yellow sessile glands, becoming sparse with age; tip acute or acuminate; base cordate, rounded or truncate; margins strongly dentate with 12-15 teeth, each 2–7 mm long, strongly toothed on juvenile foliage. Inflorescences racemose, up to 90 mm long, with dense, yellow stellate hairs; bracts lanceolate, 2.6–4 mm long, 0.8–1 mm wide, with sparse, yellow stellate hairs. Male flowers 1–7 per bract; pedicels 2–5 mm long, 0.8–1 mm diameter, with dense, yellow stellate hairs; calyx 3-lobed, lobes obovate, 3–4 mm long, 1.5–2 mm long, with sparse to dense, yellow stellate hairs; disk glands absent; stamens 28-42, free; filaments flattened-filiform, 1.5–4 mm long, c. 0.1 mm diameter, glabrous or with a few scattered, yellow stellate hairs; anthers oblong, 0.2–0.3 mm long, 0.2–0.3 mm wide, glabrous, glandular cap absent. Female flowers 1-5 per bract; pedicels 2.6–25 mm long, 2–2.5 mm diameter, with dense velutinous, yellow stellate hairs; calyx 3-lobed, lobes lanceolate, 3–5 mm long, 1.2–2 mm wide, with sparse to dense, yellow stellate hairs; ovary 3(4)-locular, subglobose, 2–3 mm long, 3–5.5 mm diameter, with dense, yellow stellate hairs and simple echinate processes to 1 mm long that have dense, yellow simple or biseriate hairs; styles 3, 3–4 mm long, connate at base for c. 1 mm, plumose and with sparse, yellow stellate hairs on backs. Fruits subglobose, 8–10 mm long, 13–15 mm diameter, with simple echinate processes to 3 mm long that have sparse to dense, yellow simple or biseriate hairs and scattered, yellow sessile glands. Seeds ovoid, 3.8–5.5 mm long, 3.5–4.5

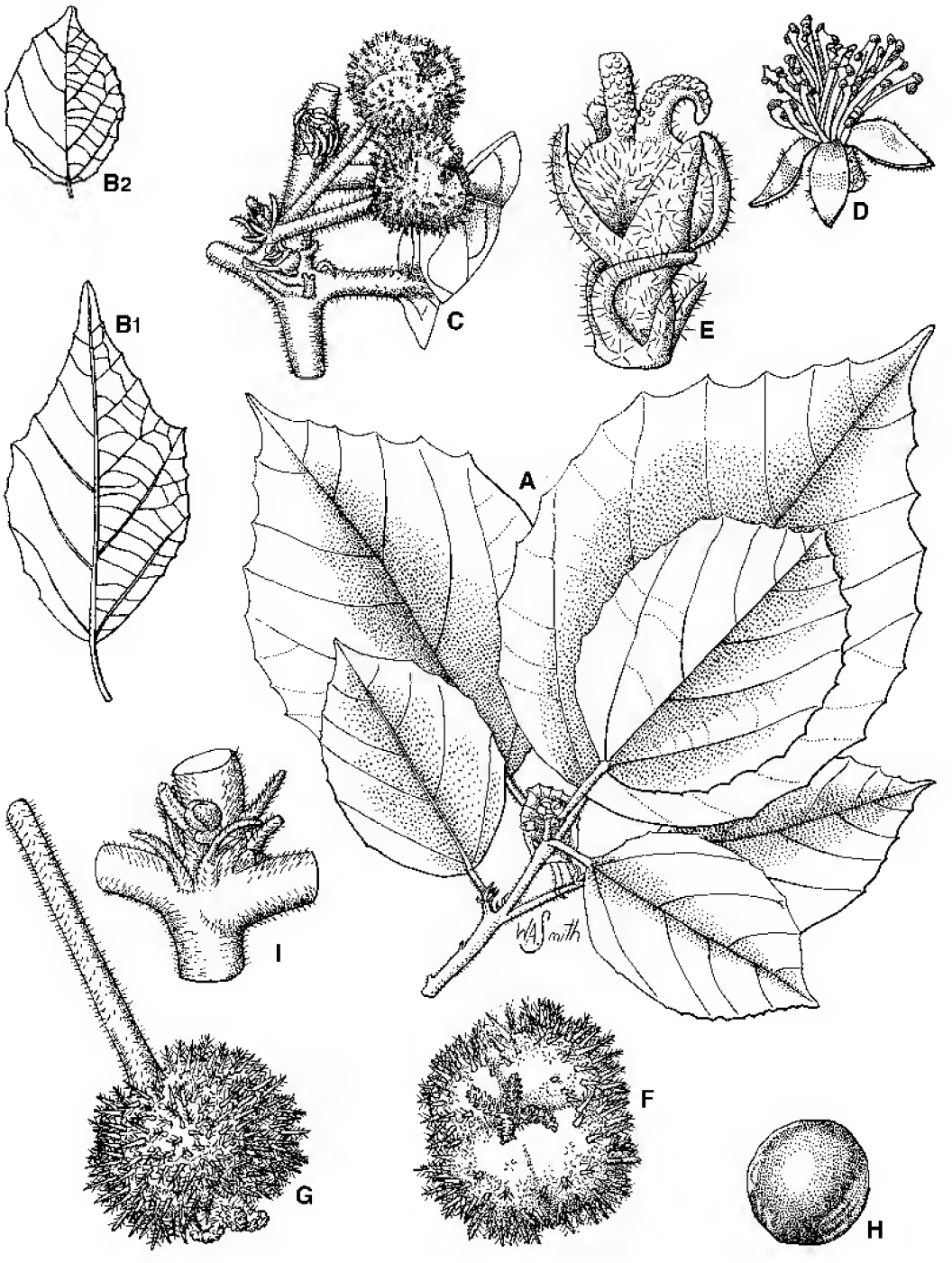


Fig. 4. Mallotus ficifolius. A. flowering twig. x 0.4. B. undersurface of leaves. x 0.4. C. fruiting inflorescence. x 1. D. male flower. x 5. E. female flower. x 5. F & G. fruit. x 2. H. seed. x 4. I. leaf node showing stipules. x 2. A, C, F, G, I from *Forster* 13591 (BRI); B1, D, E from *Forster* 13571 (BRI); B2 & H from *Forster* 8893 (BRI). Del. W. Smith.

mm wide, 3–4.5 mm thick, tan-brown. Fig. 4.

***Selected additional specimens*: Queensland.** Cook District: Cooktown Botanic Gardens, 15°28'S, 145°15'E, Nov 1988, *Burkitt* 37 (BRI); T.R. 106, Poverty L.A., 16°00'S, 145°15'E, Jul 1973, *Dockrill* 680 (BRI, QRS); Freshwater Creek, Jungara, Dec 1936, *Flecker* N.Q.N.C.2672 (BRI); 2 km SE of Kennedy Hill, 12°28'S, 143°15'E, Jul 1991, *Forster* PIF8893 (BRI); Rocky River Scrub, Silver Plains Station, eastern fall of McIlwraith Range, 13°49'S, 143°27'E, Jun 1992, *Forster* PIF10624 et al. (BRI, QRS); Chili Creek Crossing, road to Portland Roads, 12°38'S, 143°22'E, Jul 1993, *Forster* PIF13571 et al. (BRI, MEL, QRS); S.F.R. 756, East McNamee, 17°40'S, 145°50'E, Nov 1971, *Hyland* 5630 (BRI, QRS); Claudie River, 12°45'S, 143°15'E, Oct 1974, *Hyland* 7802 (BRI, CANB, QRS); Endeavour River North Arm crossing with McIvor River - Cooktown road, 15°25'S, 145°05'E, Nov 1981, *Irvine* 2177 (QRS); Gap Creek, Bloomfield, May 1978, *Scarth-Johnson* 762A (BRI); Cedar Bay, 15°49'S, 145°20'E, Jan-Mar 1973, *Tracey* 14668 (BRI); Grassy Hill, Cooktown, 15°28'S, 145°15'E, Jul 1991, *Waterhouse* 1870 (BRI, DNA, MBA). South Kennedy District: Port Mackay, [undated] *Dietrich* 2479 (AD). Port Curtis Curtis: "Netherleigh", c. 26 km SE of Calliope, 24°14'S, 151°20'E, Aug 1984, *Anderson* 3789 (BRI); Boynedale, near Gladstone, Nov 1980, *Cowie* 52 (BRI); Moores Creek, Berserker Range, 23°19'S, 150°33'E, Nov 1992, *Forster* PIF12257 & *Machin* (BRI, K, L, MEL, QRS); Pine Creek off lower reaches of Granite Creek, S.F. 391 Bulburin, 24°37'S, 151°33'E, Dec 1993, *Forster* PIF14583 et al. (BRI); Iveragh Creek, Castletower, Portion 9, 22 km SE of Calliope, 24°07'S, 151°21'E, Oct 1988, *Gibson* TOI297 (BRI, NSW); Moores Creek, 23°20'S, 150°35'E, Oct 1976, *Hyland* 9086 (BRI, QRS); North Rockhampton, Jul 1935, *White* 12143 (BRI).

***Distribution and habitat*:** *Mallotus ficifolius* is endemic to Queensland but is disjunct in its occurrence with populations on Cape York Peninsula, the 'Wet Tropics', Mackay (historical only and perhaps the locality is suspect) and from Rockhampton south to Granite Creek (Map 4). Plants grow on the margins of notophyll vineforest, along seasonal watercourses or on woodland on grassy hillsides.

***Phenology*:** Flowers and fruits throughout the year.

***Notes*:** *Mallotus ficifolius* is a variable species in leaf size with some very small forms and some large ones. Airy-Shaw considered *Mallotus ficifolius* as a variety of *M. claoxyloides* and also chose to recognise the variety *cordatus* as distinct, although he did mention that the two were doubtfully distinct. Some plants, particularly those near Rockhampton are very small (< 1.5 m high) in stature and in foliage size. All of the plants in the north of the state are much larger in stature and foliage, as are those from near Gladstone in more mesic conditions than the Rockhampton ones. It is usually possible to find some small leaves on predominantly large-leaved plants, hence it is concluded that leaf size is dependent on seasonal moisture availability.

This species is predominantly dioecious, although there is at least one known example (*Waterhouse* 1870) where plants are definitely monoecious.

There are two sheets [MEL515958 & 515951] at MEL collected by Dallachy at Rockhampton that qualify as syntypes of *Mallotus claoxyloides* var. *ficifolius*. MEL515951 is the better sheet with both male and female twigs, as well as a date, and is selected here as lectotype of the name.

***Conservation status*:** Not at risk at this stage. Present in Iron Range N.P. and Mt Archer C.P. at Rockhampton.

***Etymology*:** The specific epithet is derived from Latin and alludes to the resemblance of the foliage to that of some species of *Ficus* (Moraceae).

***Uses*:** None recorded.

5. Mallotus megadontus P.I.Forst., **stat. et nom. nov.** *Mallotus claoxyloides* var. *angustifolia* F.M.Bailey, Bot. Bull. 2: 18 (1891). [non *Mallotus angustifolius* Benth.] **Type:** Queensland. Moreton District: Maroochy (Yandina), 1 Mar 1891, *F.M. Bailey* (holo: BRI; iso: MEL [MEL708570]).

Mallotus sp. (Cooroy P.R.Sharpe+ 4913) (Forster & Henderson 1997: 74).

Small shrub 0.5–2 m high; evergreen, perennial, monoecious, often functionally dioecious. Stems flattened towards apices, with sparse, clear to ginger simple and stellate hairs when young, glabrescent and lenticellate with age.

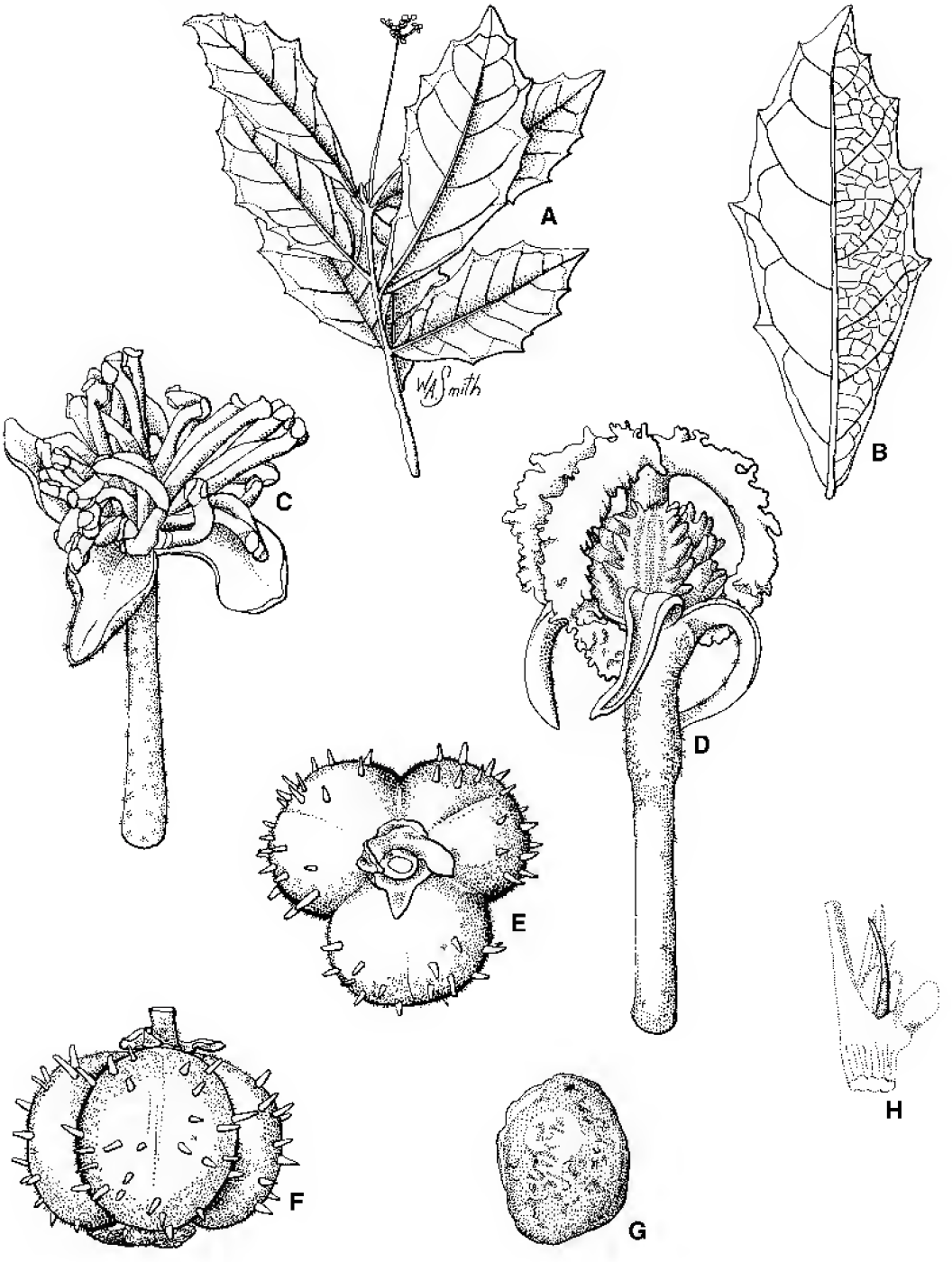


Fig. 5. ***Mallotus megadontus***. A. flowering twig. x 0.5. B. undersurface of leaf. x 1. C. male flower. x 8. D. female flower. x 8. E & F. fruit. x 4. G. seed. x 4. H. internode with stipule emphasized. x 4. A-C from *Smith* 5149 (BRI); D from *Bean* 970 (BRI); E & F from *Simmonds* AQ203722 (BRI); G & H from *Sharpe* 4782 (BRI). Del. W. Smith.

Stipules linear-lanceolate, 2.5–4 mm long, 0.6–1.1 mm wide, with sparse, clear to yellow stellate hairs. Leaves opposite, not peltate, petiolate, discolorous; petioles 2–9 mm long, 1–1.5 mm diameter, with sparse, ginger to yellow stellate hairs; basilaminar glands 2–5 per side of midrib towards lamina base, ellipsoid, 0.4–1 mm long, 0.3–0.5 mm wide; lamina oblanceolate or obovate, rarely rhombic-ovate, 17–160 mm long, 5–70 mm wide; penninerved, comprising 11–17 lateral veins per side of midrib and reticulate interlateral veins; upper surface glossy dark-green, lateral and interlateral veins well developed, without granular inclusions, with scattered to sparse, yellow stellate hairs when young, glabrescent; lower surface pale green, lateral and interlateral venation well developed, with sparse, clear to ginger stellate hairs when young, glabrescent; tip acute, short acuminate or rarely obtuse; base cuneate to weakly attenuate; margins strongly dentate with 4–7 teeth, each 2–9 mm long. Inflorescences racemose, up to 60 mm long, with sparse, clear to ginger stellate hairs; bracts linear-lanceolate, 1–2.5 mm long, 0.2–0.3 mm wide, with sparse, clear to ginger stellate hairs. Male flowers 1–5 per bract; pedicels 3–5 mm long, 0.5–0.9 mm diameter, with sparse, clear to ginger stellate hairs; calyx 3-lobed, lobes obovate, 3–4.2 mm long, 1.5–2.5 mm long, with sparse, clear to ginger stellate hairs; disk glands absent; stamens 40–60, free; filaments filiform, 1.5–3.5 mm long, 0.2–0.3 mm diameter, glabrous; anthers oblong, 0.4–0.5 mm long, 0.6–0.7 mm wide, glabrous, glandular cap absent. Female flowers 1 per bract; pedicels 1–16 mm long, 0.7–1 mm diameter, with sparse, clear to ginger stellate hairs; calyx 3 or 4-lobed, lobes lanceolate, 3–3.9 mm long, 1–1.4 mm wide, with sparse, yellow stellate hairs and scattered yellow sessile glands; ovary 3-locular, subglobose, c. 2 mm long and 2.5 mm diameter, with dense yellow stellate hairs, scattered yellow sessile glands and simple echinate processes 0.1–0.4 mm long; styles 3, 2.5–4 mm long, connate at base 0.5–0.7 mm, plumose with scattered simple hairs on backs. Fruits subglobose, 5–7 mm long, 8–10 mm diameter, with sparse to dense, yellow stellate hairs, scattered yellow sessile glands and simple, echinate processes 0.5–2 mm long. Seeds ovoid, 4.8–6 mm long, 4.2–4.5 mm wide, 3.8–4.5 mm thick, tan-brown. Fig. 5.

***Specimens examined*: Queensland.** MORETON DISTRICT: Bank of Petrie Creek, W of Woombye, 26°40'S, 152°55'E, Nov 1988, *Bean* 970, 971 (BRI); 6 km W of Woombye, 26°39'S, 152°55'E, Feb 1990, *Bean* 1347 (BRI); Platypus Creek, Dulong, west of Nambour, 26°38'S, 152°54'E, Dec 1993, *Bean* 7199 & 7200 (BRI); Council Beauty Spot, 1 km E of Mt Cooroy, 26°26'S, 152°58'E, Nov 1990, *Forster* PIF7593 & *Sharpe* (BRI); Kureelpa Falls, 26°35'S, 152°53'E, Dec 1992, *Forster* PIF12440 & *Sharpe* (BRI); Buderim Mt, Jan 1919, *Gwyther* [AQ203725] (BRI); Eerwah Creek, base of Mt Eerwah, c. 5 km W of Eumundi - Kenilworth road, 26°28'S, 152°54'E, Jan 1988, *Sharpe* 4782 (BRI, NSW); Mt Cooroy, c. 4 km E of Cooroy, 26°26'S, 152°57'E, Nov 1988, *Sharpe* 4837 et al. (BRI); ditto, Nov 1989, *Sharpe* 4913 & *Thomas* (BRI); ditto, Oct 1989, *Sharpe* 4901 & *Bean* (BRI); ditto, Nov 1989, *Sharpe* 4913 & *Thomas* (BRI); Yandina, Mar 1891, *Simmonds* [AQ203722] (BRI); Eumundi, Oct 1918, *Simmonds* [AQ203724] (BRI); Yatala, 27°44'S, 153°13'E, Dec 1953, *Smith* 5149 (BRI).

***Distribution and habitat*:** Restricted to the Moreton district of south-east Queensland (Map 6). Plants grow on the margins or in notophyll vineforest often near watercourses.

***Phenology*:** Flowers October to March, fruits December to April.

***Notes*:** *Mallotus megadontus* has been known as the variety *angustifolius* of *M. claoxyloides* since its description by Bailey (1891). *Mallotus megadontus* differs from *M. claoxyloides* most noticeably in the strongly dentate leaf laminae; the leaves with 11–17 lateral veins and lacking sessile yellow glands below; male flowers with thicker staminal filaments (0.2–0.3 mm diameter); and smaller fruit (8–10 mm diameter).

***Conservation status*:** *Mallotus megadontus* is infrequent in south-east Queensland and much suitable habitat throughout its range has been cleared or will be in the near future. The species was not found to occur in any conservation reserves by Forster et al. (1991) in their survey of 232 remnant patches of vineforest in south-east Queensland. An appropriate conservation coding is Rare.

***Etymology*:** The new name is derived from the Greek *mega* (big) and *dontus* (tooth) and alludes to the prominent teeth on the leaf lamina of this species.

***Uses*:** None recorded.

6. Mallotus mollissimus (Geisel.) Airy Shaw, Kew Bull. 26: 297 (1971); *Croton mollissimus* Geisel., Croton Monogr. 73 (Mar 1807); *Echinus mollissimus* (Geisel.) Baill., Adansonia 6: 316 (1866). **Type:** Chine [China], *Staunton* (iso: G-DC (single leaf) n.v. [fiche at BRI]).

Croton ricinoides Pers., Syn. 2: 586 (Sep 1807); *Mallotus ricinoides* (Pers.) Muell.Arg., Linnaea 34: 187 (1865). **Type:** Inde [India], 1800, *Lahaye* (lecto [here designated]: P-JU 16578 n.v. [fiche at BRI]).

Mallotus pycnostachys F.Muell., Fragm. 4: 138 (1864). **Type:** Queensland. North Kennedy District: Mt Elliott, 5 Aug 1863, [MEL232434, 232433, 232430, 232432] (holo: MEL).

***Illustration*:** Christophel & Hyland (1993: 108, t.46 B).

Shrub or small tree to 10 m high; evergreen, perennial, monoecious. Stems ± rounded, with dense, clear to ginger stellate hairs, indumentum persistent. Stipules acuminate-linear, 1.2–1.5 mm long, 0.5–0.8 mm wide, with dense, clear to ginger stellate hairs. Leaves alternate, ± peltate, petiolate, discolorous; petioles 13–230 mm long, 2–3 mm diameter, with dense velutinous, clear to ginger stellate hairs; basilaminar glands usually absent or 1 per side of midrib towards lamina base, ellipsoid, 1.3–1.7 mm long, 0.8–1 mm wide; lamina broadly-ovate, orbicular-ovate or ovate, 45–30 mm long, 22–240 mm wide; venation palminerved, comprising 4 veins from the lamina base, 5–8 lateral veins per side of midrib and reticulate interlateral veins; upper surface matt dark-green, lateral veins barely visible, interlateral veins not visible, without granular inclusions, with dense ginger stellate hairs when young; lower surface silver-white, lateral venation and interlateral venation well developed, with dense velutinous, clear to ginger stellate hairs and dense yellow sessile glands, indumentum persistent; tip short to long acuminate; base cordate, rounded or truncate; margins weakly sinuate or weakly dentate with 10–12 small teeth to 1 mm long. Inflorescences paniculate, up to 170 mm long, with dense velutinous, clear to ginger stellate hairs; bracts linear-lanceolate, 2–5 mm long, 0.4–0.5 mm wide, with dense clear to ginger stellate hairs. Male flowers 1–3 per bract; pedicels 2–2.2 mm long, 0.5–0.6 mm diameter, with dense clear to ginger stellate hairs; calyx 3 or 4-lobed, lobes obovate, 3–4 mm long, 2–2.5 mm long, with dense, clear stellate hairs; disk glands consisting of small irregular lobes; stamens 66-78, free; filaments filiform, 2–5 mm long, c. 0.1 mm diameter, glabrous or with occasional stellate hairs; anthers oblong, 0.3–0.4 mm long, 0.3–0.4 mm wide, glabrous, glandular cap absent. Female flowers 1 per bract; pedicels 1–2 mm long, c. 1 mm diameter, with dense, clear to ginger stellate hairs; calyx 4–lobed, lobes lanceolate-ovate, 2.5–3.5 mm long, 1.5–2 mm wide, with dense, clear to ginger stellate hairs; ovary 3–locular, subglobose, 2–2.5 mm long, 2–3 mm diameter, with dense clear stellate hairs, without echinate processes. Styles 3(4), 2–3 mm long, connate at base for c. 0.5 mm, plumose with dense clear stellate hairs on backs. Fruits subglobose to globose, 5–8 mm long, 7–8 mm diameter, with dense, clear stellate hairs and long echinate processes to 4 mm long that coalesce between adjacent fruit creating a woolly mass. Seeds globose-ovoid, 3.5–4.5 mm long, 3–4 mm wide, 2.8–3 mm thick, tan-black. Fig. 6.

***Selected additional specimens*: Queensland.** Cook District: 2.5 km S of the Lions Den Hotel, Helenvale, 15°43'S, 145°13'E, Jan 1992, *Forster* PIF9526 (BRI, K, L, MEL, QRS); Middle Claudie River Scrub, 12°44'S, 143°14'E, Jun 1994, *Forster* PIF15401 & *Tucker* (BRI, QRS); Home Rule, 15°45'S, 145°17'E, Jul 1994, *Forster* PIF15563 et al. (BRI, MEL, QRS); Cape Kimberley road, 3 km E of Cape Tribulation road, 16°16'S, 145°27'E, Jul 1993, *Forster* PIF13676 *et al.* (A, BRI, K, L, MEL, QRS); S.F. 191 Wongabel, 17°19'S, 145°30'E, Dec 1993, *Forster* PIF14442 (BRI, MEL,QRS); McIvor River, 15°10'S, 145°05'E, Jul 1972, *Hyland* 6267 (BRI, QRS); Johnstone River, Aug 1916, *Michael* [AQ204000] (BRI); Innisfail, *Michael* 401 (BRI); Tolga, Dec 1961, *Wyatt* 9 (BRI). North Kennedy District: Between Mt Fox, Nov 1949, *Clemens* [AQ198257] (BRI); Near Manifold, 22°40'S, 150°45'E, Oct 1976, *Hyland* 9061 (BRI, QRS); Murray River & Lagoon Creek, c. 5 km NE of Bilyana, Jun 1978, *Thorsborne & Travers* (BRI). South Kennedy District: Eungella Range, Jul-Nov 1947,

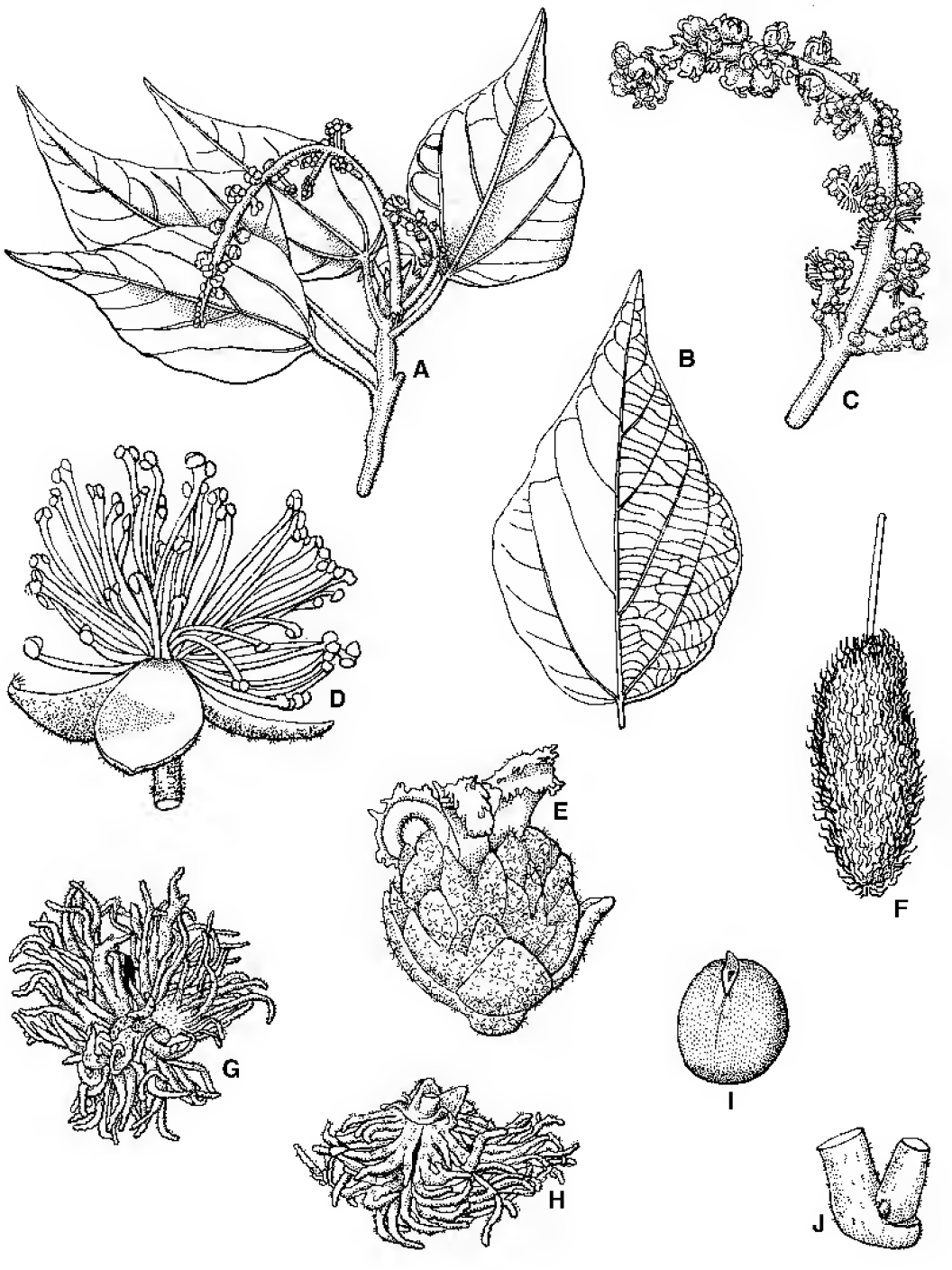


Fig. 6. ***Mallotus mollissimus***. A. flowering twig. x 0.5. B. undersurface of leaf. x 0.5. C. inflorescence. x 1. D. male flower. x 8. E. female flower. x 8. F. fruiting inflorescence. x 0.5. G & H. fruit. x 2. I. seed. x 4. J. node with stipule. x 2. A, C, D, E & J from *Forster* 12442 (BRI); B, F, G, H & I from *Forster* 16122 (BRI). Del. W. Smith.

Clemens [AQ198256] (BRI); Upper East Funnel creek, Sarina Range, Nov 1986, *Ritchie* 36 (BRI). Port Curtis District: S.F. 391 Bulburin, Camp Creek Crossing, 24°36'S, 151°33'E, Dec 1993, *Forster* PIF14578 et al. (BRI, MEL, QRS); Byfield near Keppel Bay, Sep 1931, *White* 8199 (BRI). Wide Bay District: Kin Kin, Mar 1916, *Francis & White* [AQ204007] (BRI); Mt Wolvi, 26°11'S, 152°52'E, Dec 1992, *Forster* PIF12442 & *Sharpe* (BRI, DNA, K, L, MEL, QRS); Gympie, Oct 1928, *Simmonds* [AQ204009] (BRI); Kin Kin, c. 3 km NE of township on Wolvi road, 26°16'S, 152°52'E, Jan 1993, *Sharpe* 5392 (AD, BRI, MEL, NSW).

Distribution and habitat: *Mallotus mollissimus* is widespread in north Queensland and with several disjunct populations in central and southern Queensland. It occurs in Cook, North Kennedy, South Kennedy, Port Curtis and Wide Bay districts (Map 5). The species is also widespread in Malesia and Melanesia. Plants grow as pioneers along creek banks in open forest or the margins of notophyll and mesophyll vineforests on volcanic soils.

Phenology: Flowers and fruits throughout the year.

Notes: Geiseler (1807) based his taxa on material in the Vahl herbarium. He did not specifically designate a collector for the type collection of *Croton mollissimus*; however, J. Mueller (1866) stated that the *Staunton* collection from China was the type. I could not locate any specimens for a type on the microfiche of the Vahl herbarium at C; however, on the fiche of the De Candolle herbarium at G, amongst the collections labelled as *M. ricinoides*, there is a single leaf collected by Staunton. This botanical scrap is considered an isotype. A search at C and other herbaria is required to determine if a better duplicate exists of the Staunton collection.

No collector was designated for the type collection of *Croton ricinoides*. On the fiche at P-JU, there is a single collection from India s.l. [as Inde] collected by Lahaye in 1800. As there appears to be no other specimen suitable for this type, I have designated it the lectotype of the name.

F. Mueller (1864) described *Mallotus pycnostachya* without referring to material from outside Australia, and his name was soon synonymised both by J. Mueller (1865) and Baillon (1866). There are four sheets at MEL in red type folders that are thought to represent type material of Mueller's *Mallotus pycnostachya*. Two sheets have large single leaves, whereas the others have fruiting twigs. While the label data is incomplete and varies slightly between the four, it is probable that they are all part of the same collection that has been mounted on separate sheets.

Conservation status: *Mallotus mollissimus* is a common plant in the northern part of its Australian range; however, it is very infrequent and probably endangered in south-east Queensland (Forster et al. 1991). The populations at Kin Kin and Mt Wolvi are in grossly disturbed habitats and susceptible to destruction from agricultural clearing or road maintenance.

Etymology: The specific epithet is derived from Latin and alludes to the 'soft, pliant' nature of the foliage.

Uses: None recorded. Probably useful as a pioneer species in rainforest rehabilitation projects.

7. Mallotus nesophilus Muell.Arg., Linnaea 34: 196 (1865); *Echinus nesophilus* (Muell.Arg.) Baill., Adansonia 6: 314 (1866). **Type:** Queensland. Cook District: Sweers Island, *Henne* (lecto [here designated]: MEL [MEL708600]; isolecto: G-DC n.v. [fiche at BRI]); lectopara: Cape Flinders, 1819, *A. Cunningham* 295 (G-DC n.v. [fiche at BRI]); Quail Island, 1855, *Flood* (G-DC n.v. [fiche at BRI], MEL [MEL708678]).

Illustrations: Brock (1988: 248); Christophel & Hyland (1993: 109, t.47B); Kenneally et al. (1996: 105).

Shrub or small tree to 8 m high; evergreen, perennial, dioecious. Stems ± rounded towards apices, with sparse to dense, clear, simple and stellate hairs when young, glabrescent and lenticellate with age. Stipules apparently absent. Leaves alternate or rarely subopposite, not peltate, petiolate, discolorous; petioles 3–120 mm long, 0.5–1.5 mm diameter, with sparse, clear, simple, biseriate or stellate hairs; basilaminar

glands 1 or 2 per side of midrib towards lamina base, circular to ellipsoid, 0.5–1 mm long, 0.4–0.5 mm wide; lamina obovate, orbicular, ovate, rhombic-ovate, 10–170 mm long, 5–80 mm wide; venation ± palminerved, comprising 1 or 2 lateral veins from the lamina base, an additional 5–7 lateral veins further up the midrib and with reticulate interlateral veins; upper surface glossy dark-green, lateral veins visible, interlateral veins not visible, with scattered to dense, clear, simple, biseriate or stellate hairs, glabrescent, without granular inclusions; lower surface silver-green, lateral and interlateral venation well developed, velutinous with dense, clear ± peltate scales, simple, biseriate or stellate hairs (or a combination thereof) and dense yellow sessile glands, indumentum persistent; tip acute, short acuminate or rounded; base cordate, cuneate or rounded; margins generally entire, but sometime weakly dentate with 6–10 teeth up to 2 mm long. Inflorescences racemose, up to 70 mm long, with dense, clear, simple, biseriate or stellate hairs; bracts lanceolate-ovate, 0.4–1 mm long, 0.4–0.8 mm wide, with dense, clear stellate hairs. Male flowers 1–5 per bract; pedicels 1.2–3 mm long, 0.4–0.8 mm diameter, with dense, clear stellate hairs; calyx 3 or 4–lobed, lobes obovate, 1.5–3 mm long, 1.4–2.6 mm long, with dense, clear stellate hairs and scattered yellow, sessile glands; disk glands absent; stamens 50–60; filaments fused at base for varying degrees, flattened, 0.5–1.2 mm long, c. 0.1 mm diameter, glabrous; anthers oblong, 0.5–0.6 mm long, 0.2–0.4 mm wide, with a well-developed orange glandular cap. Female flowers 1 per bract; pedicels 0.5–1 mm long, 0.5–0.8 mm diameter, with dense, clear stellate hairs and scattered orange, sessile glands; calyx 3 or 4–lobed, lobes lanceolate, 1-2 mm long, 0.5–1 mm wide, with dense, clear stellate hairs and scattered yellow, sessile glands; ovary 3–locular, subglobose, 1–2 mm long, 1.3–2.2 mm diameter, with dense, orange sessile glands, without echinate processes; styles 2 or 3, 1.2–2 mm long, connate at base for c. 0.4 mm, plumose, glabrous on backs. Fruits subglobose, possibly indehiscent, 4–8 mm long, 5.5–6 mm diameter, with dense, orange sessile glands. Seeds globose-ovoid, 3–4 mm long, 3–3.5 mm wide, 2.5–3 mm thick, tan-black. *Yellow ball flower* (Kenneally et al. 1996). Fig. 7.

***Selected additional specimens*: Western Australia.** Walcott Inlet, 16°27'S, 124°50'E, Jan 1989, *Hyland* 13829 (QRS); Gallery Hill area, Abydos/Woodstock Reserve, North Pilbara region, 21°48'S, 119°10'E, Mar 1988, *Tinley* 3239 (PERTH); Broome, Jetty Wharf road, Kimberley Region, 17°58'S, 122°13'E, May 1981, *Tracey* 15168 (BRI, QRS). **Northern Territory.** Nitmiluk, above visitor centre, Dec 1990, *Evans* 3493 (BRI, CANB, DNA); Wessel Islands, 11°11'S, 136°44'E, Sep 1972, *Latz* 3263 (BRI, DNA); Rangani Creek, Melville Island, 11°18'S, 130°31'E, Jun 1988, *Russell-Smith* 5755 & *Lucas* (BRI, DNA); Bathurst Island, Murrow Point, 11°23'S, 130°14'E, Jun 1988, *Russell-Smith* 5770 & *Lucas* (BRI, DNA); 10 km NW of mouth of Rosie Creek, 15°22'S, 136°06'E, Jan 1989, *Russell-Smith* 6764 & *Lucas* (BRI, DNA); Port Bradshaw, 12°27'S, 136°42'E, Jul 1948, *Specht* 736A (AD, BRI, CANB). **Queensland.** Cook District: S of Aurukun, 13°28'S, 141°37'E, Jul 1988, *Dalliston* CC415 (BRI); Newcastle Bay, headland between Narau & Nanthau beaches, 10°47'S, 142°35'E, Jan 1990, *Forster* PIF6384 (BRI, QRS); Lake Patricia, Weipa, 12°38'S, 141°49'E, Dec 1993, *Forster* PIF14406 (BRI); Southern end of Esplanade, Yorkeys Knob, Cairns, 16°49'S, 145°44'E, Jan 1987, *Lyons* 17 (BRI); Archer River, 13°26'S, 142°56'E, Jun 1989, *Sankowsky* 1002 et al. (BRI); Stanley Island, 14°09'S, 144°14'E, Aug 1979, *Smyth* [AQ412668] (BRI). Burke District: Woodu, between Nyuldorg & Thabugan Point, northern most coast of Mornington Island, Sep 1981, *Fosberg* 620087 (BRI); Between Tully & Massacre Inlets, Gulf of Carpentaria, 16°12'S, 138°10'E, Aug 1988, *Hyland* 13572 (QRS); Lawn Hill N.P., 18°42'S, 138°29'E, Jan 1989, *O'Keefe* [AQ454825] (BRI). North Kennedy District: Horseshoe Bay, Magnetic Island, 19°07'S, 146°52'E, Feb 1992, *Bean* 3932 (BRI); Emmett Creek, Bowling Green Bay N.P., 19°27'S, 147°03'E, Jan 1993, *Forster* PIF12741 & *Bean* (BRI, QRS).

***Distribution and habitat*:** *M. nesophilus* is widespread in tropical parts of Western Australia, the Northern Territory and Queensland (Map 7). Plants grow in vinethickets and vineforests often near the sea or sometimes inland for considerable distances in refugia in gorges and gullies.

***Phenology*:** Flowers and fruits throughout the year.

***Notes*:** A specimen of *Mallotus nesophilus* was incorrectly identified as *M. tiliifolius* by Airy Shaw (1981) resulting in the erroneous recording of that species for Australia.

The name *Echinus nesophilus* requires lectotypification as there are many original syntypes. The best of these syntypes is the one collected by *Henne* and this is selected as

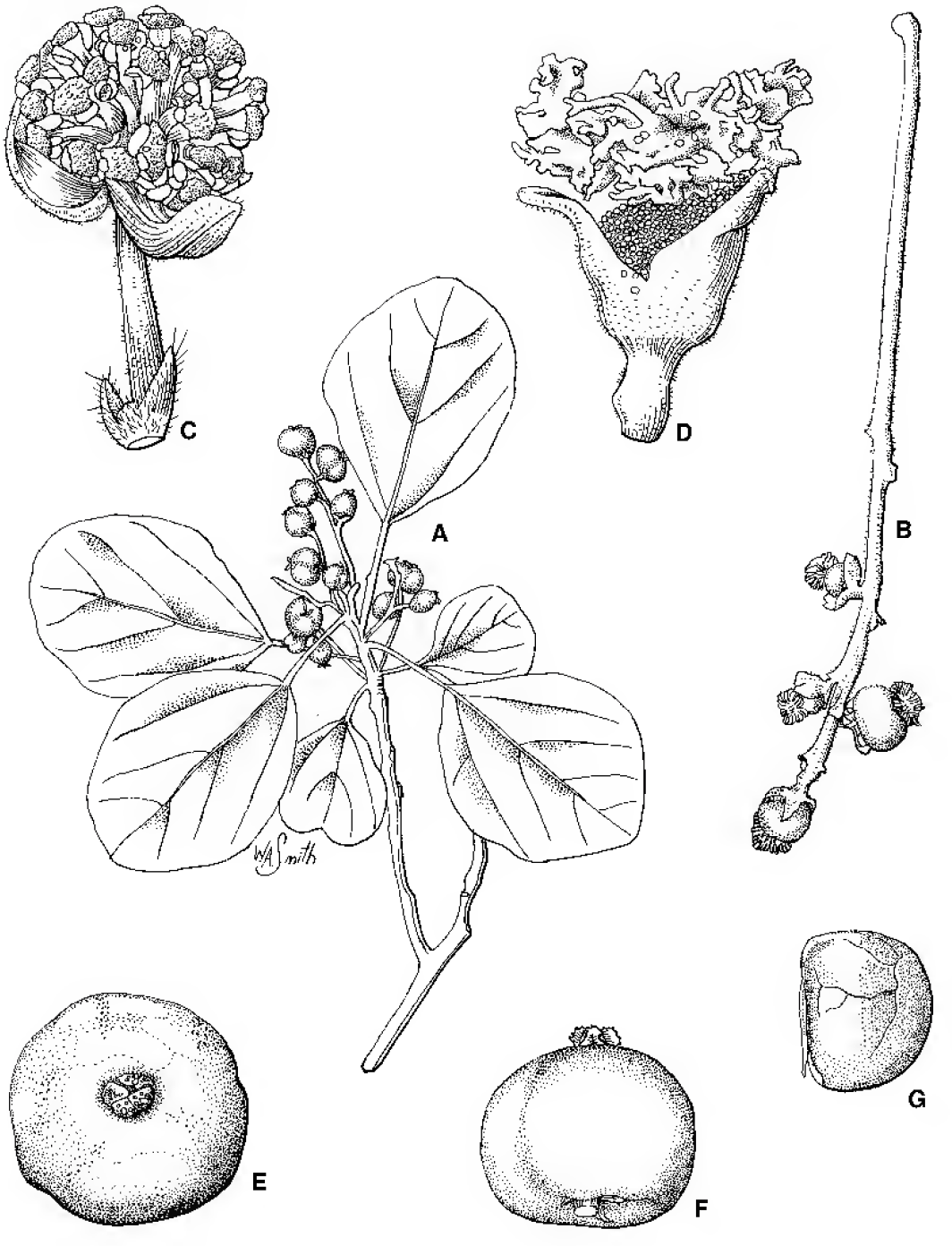


Fig. 7. ***Mallotus nesophilus*** A. fruiting twig. x 1. B. inflorescence. x 2. C. male flower. x 12. D. female flower. x 12. E & F. fruit. x 3. G. seed. x 6. A from *Cowie* 3139 (BRI); B from *Forster* 20899 (BRI); C from *O'Reilly* 411 (BRI); D from *Russell-Smith* 5770 (BRI); E-G from *Lyons* 517 (BRI). Del. W. Smith.

lectotype of the name.

Mallotus nesophilus is quite variable in terms of its leaf morphology and indumentum density. Plants from windswept coastal locations tend to have smaller leaves with shorter and denser coverage of trichomes, whereas plants from some inland localities may have relatively few trichomes on the lower leaf surface.

***Conservation status*:** Widespread. Not endangered or rare.

***Etymology*:** The specific epithet is derived from the Greek *neso* (island) and *philus* (loving) and refers to many of the syntypes having been collected from islands.

***Uses*:** The fruit are edible (Kenneally et al. 1996).

8. Mallotus paniculatus (Lam.) Muell.Arg., Linnaea 34: 189 (1865); *Croton paniculatus* Lam., Encycl. Méth., Bot. 2: 207 (1786). **Type:** Java, *Commerson* (holo: P-JU 16579 n.v. [fiche at BRI]).

Mallotus cochinchinensis Lour., Fl. Cochinch. 635 (1790). **Type:** 'Habitat sepes, et hortos minus cultos Cochinchinae, & Chinae', *Loureiro* (holo: BM n.v. [photo at BRI]).

***Illustration*:** Christophel & Hyland (1993: 109, t. 47C).

Shrub or small tree to 6 m high; evergreen, perennial, monoecious or often functionally dioecious. Stems ± rounded towards apices, with dense, clear to ginger to silver stellate hairs when young often appearing almost peltate, becoming sparse with age. Stipules acute-lanceolate, 0.5–1 m long, 0.4–0.5 mm wide, with dense ginger to silver ±peltate hairs. Leaves alternate, not peltate, petiolate, discolorous; petioles 30–180 mm long, 1.5–2 mm diameter, with dense, ginger to silver, stellate hairs; basilaminar glands one per side of midrib at lamina base, ellipsoid, 1–2.8 mm long, 0.6–1.8 mm wide; lamina broadly ovate, rhombic-ovate, 40–190 mm long, 22–120 mm wide; venation palminerved, 3–5 lateral veins from the lamina base, an additional 6–8 lateral veins further up the midrib and with reticulate interlateral veins; upper surface matt dark-green, lateral veins just visible, interlateral veins not visible, without granular inclusions, with dense, ginger to silver stellate hairs, glabrescent; lower surface silver-white, lateral and interlateral venation well developed, with dense, ginger to silver stellate hairs, yellow sessile glands generally absent, indumentum persistent; tip short or long acuminate; base cuneate to truncate; margins generally entire, weakly sinuate, or very weakly dentate with poorly defined teeth. Inflorescences paniculate, up to 300 mm long, with dense, ginger to silver, stellate hairs; bracts lanceolate to lanceolate-ovate, 1–3 mm long, 0.4–0.8 mm wide, with dense, ginger to silver stellate hairs. Male flowers 1–5 per bract; pedicels 3–5 mm long, 0.5–0.6 mm diameter, with dense, ginger to silver stellate hairs; calyx 3- or 4-lobed, lobes lanceolate-ovate or obovate, 2.2–3 mm long, 1.5–2.3 mm long, with dense, silver stellate hairs; disk glands absent; stamens 44–56; filaments free, filiform, 2.5–3.2 mm long, c. 0.1 mm diameter, glabrous; anthers oblong, c. 0.3 mm long and 0.4 mm wide, glandular cap absent. Female flowers 1 per bract; pedicels 0.7–1.9 mm long, 0.5–1 mm diameter, with dense, silver, stellate hairs; calyx 4-lobed, lobes lanceolate-ovate, 1.5–2.7 mm long, 1–1.7 mm wide, with dense, silver, stellate hairs; ovary 3-locular, subglobose, 1.2–1.5 mm long, 1.8-2 mm diameter, with dense, stellate hairs, echinate processes simple and up to 0.6 mm long; styles 3, 1.5–2 mm long, barely connate at base, plumose, with dense peltate hairs on backs. Fruits subglobose, 4–5 mm long, 5–6 mm diameter, with sparse ginger to silver, stellate hairs and echinate processes 3–4 mm long. Seeds ±globose, 3–3.5 mm long, 3–3.2 mm wide, 2.5–2.8 mm thick, tan. Fig. 8.

***Selected additional specimens*: Queensland.** Cook District: Mowbray River, Jan 1932, *Brass* 1961 (BRI); West Claudie River, Iron Range N.P., 12°44'S, 143°14'E, May 1992, *Fell* DGF2609 & *Butcher* (BRI, DNA, QRS); Stoney Creek, Mission Beach - Tully road, 17°55'S, 146°05'E, Jul 1989, *Forster* PIF5617 (BRI, DNA, MEL); Turpentine road, Little Cooper Creek, Daintree Freehold Rainforest, 16°10'S, 145°24'E, Feb 1994, *Forster* PIF14724 (A, BRI, MEL, QRS); Mew River, 1 km SW of Muddy Bay, Cape York, 10°44'S, 142°32'E, Jun 1994, *Forster* PIF15302 & *Tucker* (BRI); Copper Lode Falls Dam site, on Freshwater Creek, c. 6 miles [10 km] S of Cairns, 16°56'S, 145°46'E, Aug 1970, *Gittins* 2137

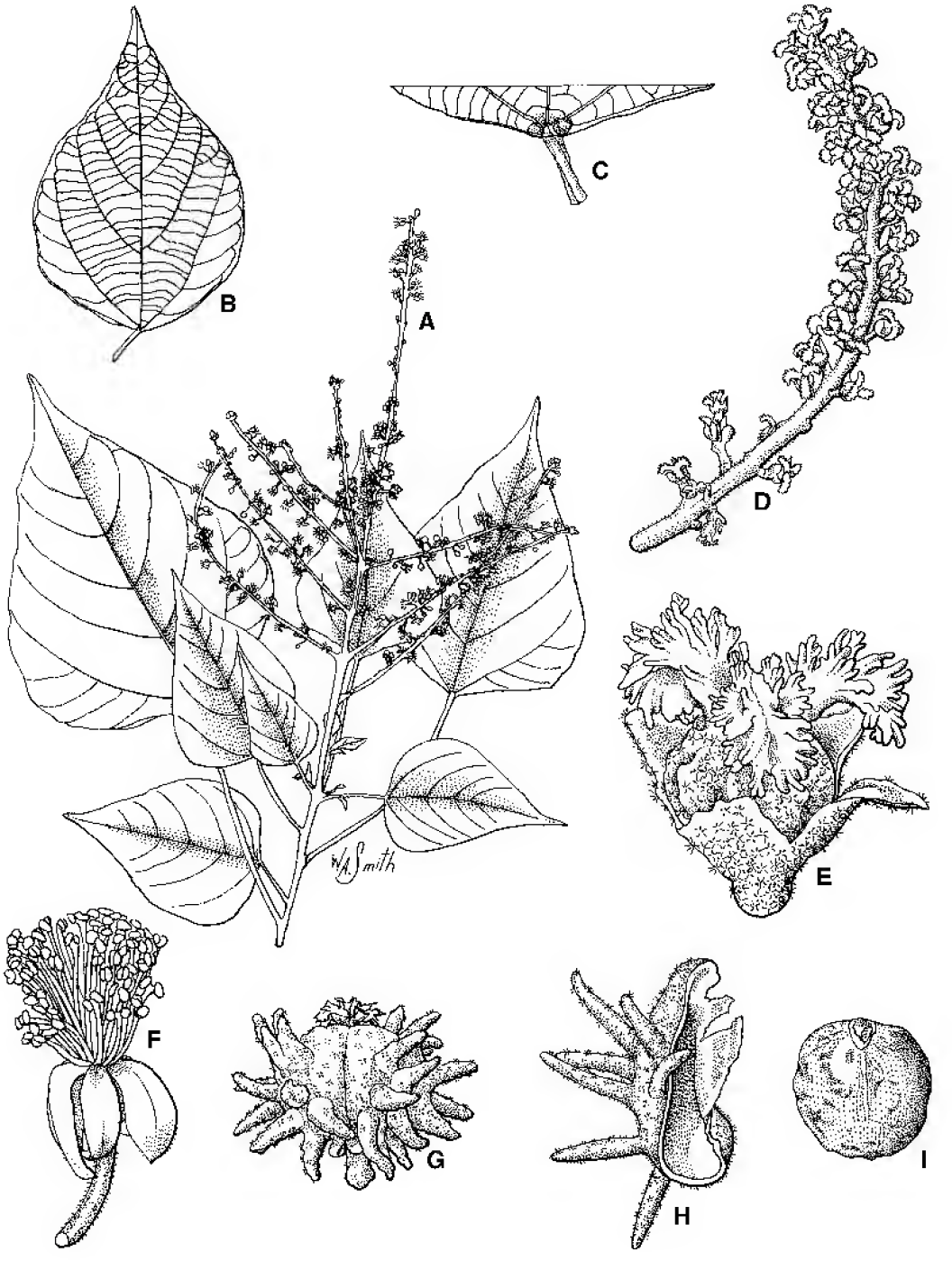


Fig. 8. ***Mallotus paniculatus***. A. flowering twig. x 0.4. B. undersurface of leaf. x 0.4. C. base of undersurface of leaf showing glands. x 0.8. D. inflorescence. x 1.5. E. female flower. x 12. F. male flower. x 6. G. fruit. x 3. H. part of dehisced fruit. x 6. I. seed. x 6. A from *Jago* 3744 (BRI); B-E from *Forster* 14323 (BRI); F-G from *Forster* 14724 (BRI), H-I from *Forster* 5617 (BRI). Del. W. Smith.

(BRI); S.F.R. 310 Parish of Gadgarra, 17°30'S, 145°41'E, Nov 1984, *Gray* 3672 (QRS); T.R. 55 Whyanbeel, 16°20'S, 145°20'E, *Hyland* 7746 (BRI, QRS); Between Lockerbie & Somerset, May 1981, *Hyland* 11062 (QRS); R1073, Rooty L.A., 16°40'S, 145°30'E, Mar 1976, *Hyland* RFK3394 (BRI, CANB, QRS); Wrights Creek, between Lakes Barrine & Eacham, Apr 1953, *Melville* 3699 *et al.* (BRI); Etty Bay, Dec 1941, *White* 11744 (BRI). NORTH KENNEDY DISTRICT: Dunk Island, Dec 1907, *Banfield* [AQ203792] (BRI); Little Crystal Creek, E of Paluma, Feb 1992, *Bean* 3923 (BRI); Wongaling Beach road, Mission Beach, 17°53'S, 146°05'E, May 1989, *Bogenhuber* 59 (BRI); "The Gorge Range", Sword Creek falls, 18 km WNW of Abergowrie, 18°27'S, 145°42'E, Mar 1988, *Fell* DGF734 (BRI); Kirrama Range, 18.5 km from Kennedy, 18°12'S, 145°50'E, Dec 1993, *Forster* PIF14316 (BRI, QRS); Tully River valley, Cardstone road, 17°51'S, 145°43'E, Dec 1993, *Forster* PIF14323 (A, BRI, MEL, QRS). SOUTH KENNEDY DISTRICT: Dalrymple Heights & vicinity, Jul-Sep 1947, *Clemens* [AQ330649] (BRI); Mt Blackwood, Mar 1987, *Thompson* 68 (BRI).

***Distribution and habitat*:** *Mallotus paniculatus* is commonly found in Queensland in the Cook (southern parts), North and South Kennedy districts, with several disjunct populations on Cape York Peninsula and adjacent Torres Strait (Map 8). The species is widespread in Asia and Malesia. Plants grow on notophyll and mesophyll vineforest margins on a variety of soils of volcanic origin.

***Phenology*:** Flowers November to July; fruits througout the year.

***Notes*:** A specimen of this species from Prince of Wales Island was incorrectly identified as *Mallotus tiliifolius* by Airy Shaw (1981).

***Conservation status*:** Common in the area of occurrence. Not threatened.

***Etymology*:** The specific epithet is derived from Latin and probably pertains to the paniculate inflorescence of this species.

***Uses*:** None recorded. Probably useful as a pioneer species in rainforest rehabilitation projects.

9. Mallotus philippensis (Lam.) Muell.Arg., Linnaea 34: 196 (1865); *Croton philippense* Lam., Encycl. Méth., Bot. 2: 206 (1786); *Echinus philippensis* (Lam.) Baill., Adansonia 6: 314 (1866). **Type:** Philippines, *Sonnerat* (holo: P-JU 16581 n.v. [fiche at BRI]).

***Illustrations*:** Williams (1979: 185, 1987: 199); Brock (1988: 248); Floyd (1989: 152); Hauser (1992: 102); Christophel & Hyland (1993: 109, t. 47D).

Shrub or small tree to 10 m high; evergreen or fleetingly deciduous, perennial, dioecious. Stems ± rounded towards apices, with dense, ginger stellate hairs and red sessile glands, glabrescent and lenticellate with age. Stipules acuminate-lanceolate, 0.6–1 mm long, 0.3–0.8 mm wide, with dense, ginger stellate hairs. Leaves alternate, not peltate, petiolate, discolorous; petioles 15–80 mm long, 0.8–1 mm diameter, with dense, clear to ginger stellate to ± peltate hairs and scattered red sessile glands; basilaminar glands 1 per side of midrib towards lamina base, spherical, 0.3–0.5 mm wide; lamina elliptic, lanceolate-ovate or obovate, 15–200 mm long, 8–100 mm wide; palminerved, comprising 2 prominent lateral veins from the lamina base, 5–7 lateral veins further along the midrib and reticulate interlateral veins; upper surface glossy dark-green, lateral and interlateral veins just visible, without granular inclusions, with sparse clear stellate hairs when young, glabrescent; lower surface grey-silver to reddish-silver, lateral and interlateral venation well developed, with dense clear simple hairs overtopping dense clear peltate scales and dense red sessile glands, indumentum persistent; tip acute, short acuminate or obtuse; base cuneate, rounded or truncate; margins generally entire or weakly sinuate; Inflorescences racemose or with 1 or 2 side branches, but not paniculate, up to 110 mm long, with dense, clear to ginger stellate hairs and scattered red sessile glands; bracts lanceolate-triangular, 0.5–1.2 mm long, 0.6–1 mm wide, with dense, ginger stellate hairs and scattered red sessile glands. Male flowers 1–3 per bract; pedicels 2–3.5 mm long, 0.3– 0.4 mm diameter, with dense, clear stellate hairs and scattered red sessile glands; calyx 3- or 4-lobed, lobes lanceolate-ovate to obovate, 2.5–2.8 mm long, 0.7–2.5 mm long, with dense, clear stellate hairs and scattered, red sessile glands; disk glands absent; stamens 20–28, free; filaments filiform, 0.5–1.5 mm long, c. 0.1 mm diameter,

glabrous; anthers oblong, 0.5–0.8 mm long, 0.5–0.7 mm wide, with a few orange-red sessile terminal glands. Female flowers 1 per bract; pedicels 0.4–2 mm long, 0.4–0.6 mm diameter, with dense, ginger stellate hairs; calyx 4-lobed, lobes lanceolate, 1.2–1.8 mm long, 0.5–0.6 mm wide, with dense, ginger stellate hairs and scattered red sessile glands; ovary 3-locular, subglobose, 1–1.5 mm long, 1.2–1.8 mm diameter, with dense, ginger stellate hairs and scattered, red sessile glands, lacking echinate processes; styles 3, 1.8–3 mm long, connate at base for 0.3–0.5 mm, plumose, with sparse ginger stellate hairs and dense red sessile glands on backs. Fruits depressed-globose, 4–7.5 mm long, 7–12 mm diameter, always with dense red sessile glands and occasionally with yellow stellate hairs. Seeds globose-ovoid, 3–5 mm long, 3–5 mm wide, 2.8–4.5 mm thick, black. *Red kamala, Orange kamala.*

***Selected additional specimens*: Northern Territory.** Wagait Reserve, 13°12'S, 130°40'E, Jan 1973, *Dunlop* 3106 (BRI, DNA); Source of Glasswater Creek, Litchfield, 13°20'S, 130°33'E, Oct 1988, *Russell-Smith* 5990 & *Lucas* (BRI, DNA). **Queensland.** Cook District: Mt Scatterbrain, Butchers Hill Station near Lakeland Downs, 15°52'S, 144°53'E, Jan 1992, *Forster* PIF9520 (BRI, DNA, K, L, MEL, QRS); Boat ramp area, Rocky Point, Weipa, 12°37'S, 141°53'E, Nov 1989, *O'Reilly* 456 (BRI, QRS). North Kennedy District: S.F. 387, 2 km SSW of dam wall on Proserpine River, 20°23'S, 148°22'E, May 1991, *Forster* PIF8316 & *McDonald* (BRI); Creek between Frederick Peak & South Pinnacle, 19°23'S, 146°38'E, Jan 1992, *Forster* PIF9467 & *Bean* (BRI, K, L, MEL, QRS). South Kennedy District: Lindeman Island, Coconut Bay, Nov 1985, *Batianoff* 3294 & *Dalliston* (BRI); Dalrymple Heights & vicinity, Jul-Nov 1947, *Clemens* [AQ198249] (BRI). Leichhardt District: Carnarvon Gorge, Jan 1989, *Morley* 16 (BRI); Isla Gorge, c. 28 km SW of Theodore, Aug 1973, *Sharpe* 623 & *Hockings* (BRI). Port Curtis District: Lower reaches of Koolkoorum Creek, S.F. 121, 24°26'S, 151°13'E, Oct 1989, *Forster* PIF5868 et al. (BRI, MEL, NSW); 25 km SW of Raglan, R146, Horrigan Creek, 23°43'S, 150°48'E, Mar 1989, *Gibson* TOI490 (BRI); Mt Larcom Range, 6 km NW of Yarwun, 23°48'S, 151°06'E, Aug 1989, *Gibson* TOI805 (BRI). Burnett District: Cania Gorge N.P., 24°42'S, 150°58'E, Oct 1983, *Henderson* 2982 et al. (BRI). Wide Bay District: Stony Creek, 4 km E of Didcot, 25°29'S, 151°54'E, Oct 1990, *Forster* PIF7529 (BRI, K, L, QRS); Mt Glastonbury, S.F. 242 Glastonbury, 26°14'S, 152°27'E, Dec 1991, *Forster* PIF9297 & *Tucker* (A, BRI, K, L, MEL, QRS). Moreton District: Currumbin Creek, Jan 1970, *Dunlop* 1607 (BRI, CBG); Upper Brookfield, Brisbane, Feb 1978, *Jessup* 54 (BRI). **New South Wales.** Whian Whian road, 1.3 km from junction of road to Whian Whian S.F., 28°39'S, 153°20'E, Dec 1986, *Murray* 78 et al. (BRI, NSW).

***Distribution and habitat*:** *Mallotus philippensis* has a wide distribution in Australia occurring in the northern part of the Northern Territory and in Cook, North Kennedy, South Kennedy, Port Curtis, Leichhardt, Burnett, Wide Bay and Moreton botanical districts in Queensland and in north-east New South Wales (Map 9). The species is also widespread in Malesia and parts of Asia. Plants grow mainly in microphyll to notophyll vineforests and vinethickets, but are frequently found in gullies or on ridges in open forest especially at rocky sites with some fire protection.

***Phenology*:** Flowers and fruits throughout the year.

***Notes*:** *Mallotus philippensis* is unique amongst the Australian species of *Mallotus* in having red sessile glands and the lower leaf lamina with persistent, ± stellate scales.

***Conservation status*:** *Mallotus philippensis* is a very common plant and is present in at least 28 conservation reserves in south-east Queensland alone (Forster et al. 1991).

***Etymology*:** The specific epithet refers to this plant having been described from a collection obtained in The Philippines.

***Uses*:** The red covering on the fruits is used to dye silk in India. The wood is suitable for tool handles and building (Floyd 1989).

10. Mallotus polyadenos F.Muell., Fragm., 6: 184 (1868). **Type:** Queensland. Cook District: Sea View Range, 11 November 1864 [*Dallachy* s.n.] (lecto [here designated]: MEL [MEL708712]).

***Illustration*:** Christophel & Hyland (1993: 109, t. 47E).

Shrub or small tree to 10 m high; evergreen, perennial, monoecious, but often functionally dioecious. Stems ± flattened towards apices, with sparse yellow to red sessile glands. Stipules acute-lanceolate, 0.8–1 mm long, 0.5–0.6 mm wide, with sparse yellow sessile glands. Leaves opposite, not peltate, petiolate,

discolorous; petioles 3–47 mm long, 0.5–1 mm diameter, with sparse to dense, yellow sessile glands; basilaminar glands 1 per side of midrib near lamina base, ellipsoid, 0.7–1 mm long, 0.5–0.7 mm wide; lamina elliptic, oblanceolate or obovate, 36–200 mm long, 15–90 mm wide; penninerved, comprising 8–12 lateral veins per side of midrib and reticulate interlateral veins; upper surface glossy dark-green, lateral and interlateral veins not visible, with sparse included granular inclusions, glabrous; lower surface pale green, lateral and interlateral venation well developed, glabrous and with dense, yellow sessile glands, occasionally also with small clumps of simple hairs forming domatia in vein angles; tip acute, short acuminate or obtuse; base cordate to cuneate; margins generally entire, but sometime weakly sinuate. Inflorescences racemose, up to 150 mm long, with scattered yellow to ginger stellate hairs and sparse yellow sessile glands; bracts triangular, c. 1 mm long, 0.6–0.8 mm wide, with an occasional simple hair and sparse yellow sessile glands. Male flowers 1–10 per bract; pedicels 2–4.5 mm long, 0.5–0.7 mm diameter, with dense, yellow stellate hairs; calyx 3 or 4-lobed, lobes oblanceolate to obovate, 3–3.5 mm long, 1.4–2.8 mm long, with scattered to sparse, yellow sessile glands; disk glands absent; stamens 38–70, free; filaments filiform, 1.5–2.7 mm long, c. 0.1 mm diameter, glabrous; anthers oblong, 0.6–0.8 mm long, 0.8–1 mm wide, glandular cap absent. Female flowers 1 per bract; pedicels 1.8–12 mm long, 0.4–0.8 mm diameter, with scattered, ginger stellate hairs and sparse yellow sessile glands; calyx 4-lobed, lobes lanceolate, 1.5–2.6 mm long, 0.6–1.2 mm wide, with sparse yellow to red sessile glands; ovary 3-locular, depressed-globose, 1–2.6 mm long, 1.5–4 mm diameter, with dense, yellow sessile glands, without echinate processes; styles 3, 1.8–3 mm long, barely connate at base for 0.2–0.3 mm, plumose, with sparse yellow sessile glands on backs. Fruits depressed-globose, 5–6 mm long, 8–10 mm diameter, with sparse, yellow sessile glands, without echinate processes. Seeds globose-ovoid, 3.3–4.5 mm long, 3–3.5 mm wide, 3.5–4 mm thick, tan-brown. Fig. 9.

***Selected additional specimens*: Queensland.** Cook District: Lower reaches of Isabella Creek, NW of Cooktown, 15°22'S, 145°00'E, Jul 1990, *Bean* 1999 (BRI); Maloney's Springs, left branch, 12°27'S, 142°53'E, Jun 1989, *Forster* PIF5272 (BRI); Nesbit River, 13°32'S, 143°32'E, Jun 1992, *Forster* PIF10528 et al. (BRI, QRS); 13.5 km along Goldsborough road, 17°14'S, 145°46'E, Jan 1993, *Forster* PIF13090 & *Bean* (BRI, MEL, QRS); Wyvuri Holding, 17°20'S, 145°58'E, Oct 1978, *Gray* 1046 (BRI, MEL, QRS); S.F.R. 1073, Buchan L.A., 16°46'S, 145°37'E, Jan 1979, *Gray* 1254 (BRI, MEL, QRS); Normanby River, N of Kalpowar, 14°40'S, 144°10'E, Oct 1970, *Hyland* 4860 (BRI, QRS); Claudie River, 12°45'S, 143°15'E, Oct 1972, *Hyland* 6458 (BRI, QRS); Between Lockerbie & Somerset, 10°47'S, 142°30'E, Dec 1980, *Hyland* 10955 (QRS); Eliott Falls, Jardine River, 11°09'S, 141°30'E, Oct 1989, *O'Reilly* 542 (BRI); Wenlock River, southern bank at Moreton Telegraph Station, 12°27'S, 142°38'E, Oct 1989, *Neldner* 2807 & *Clarkson* (BRI, MBA, QRS); 4 km S of the track to Mission River along the boundary fence between Batavia Downs & Mission River, 12°35'S, 142°32'E, Nov 1989, *Neldner* 2856 & *Clarkson* (BRI, DNA, MBA, QRS); 25 km ENE of Weipa Mission, 12°41'S, 142°07'E, Dec 1974, *Specht* W219 & *Salt* (BRI); Headwaters of Lankelly Creek on western fall of McIlwraith Range, 13°52'S, 143°20'E, Oct 1969, *Webb* & *Tracey* 9620A (BRI). North Kennedy District: 18 km WSW of Abergowrie, Sword Creek Falls N.P., Gorge Range, 18°27'S, 145°42'E, Mar 1988, *Fell* DGF739 (BRI); Emmett Creek, Bowling Green Bay N.P., 19°27'S, 147°03'E, Dec 1993, *Forster* PIF14306 (BRI, QRS); Tully Falls, 17°46'S, 145°33'E, Dec 1993, *Forster* PIF14334 (BRI, QRS); Impulse Creek, Conway Forest, 20°30'S, 148°50'E, Nov 1986, *Perry* [AQ431860] (BRI); c. 13 km WNW of Cardwell, 18°14'S, 145°54'E, Oct 1976, *Thorsborne* 295 & *Thorsborne* (BRI); Brandy Creek road, c. 3.6 km E of Shute Harbour Road & 13 km NE of Proserpine, 20°21'S, 148°40'E, Nov 1985, *Sharpe* 4052 & *Perry* (BRI).

***Distribution and habitat*:** In Australia *Mallotus polyadenos* is found in the Cook and North Kennedy botanical districts (Map 2). The species is also found in New Guinea. Plants grow in semi-evergreen to evergreen notophyll vineforests near permanent or seasonal watercourses.

***Phenology*:** Flowers and fruits throughout the year.

***Notes*:** There are numerous specimens at MEL collected by Dallachy that may be syntypes of this name. I have chosen a specimen (MEL708712) that was collected prior to the publication of the name and is copiously annotated by Mueller.

***Conservation status*:** Widespread and

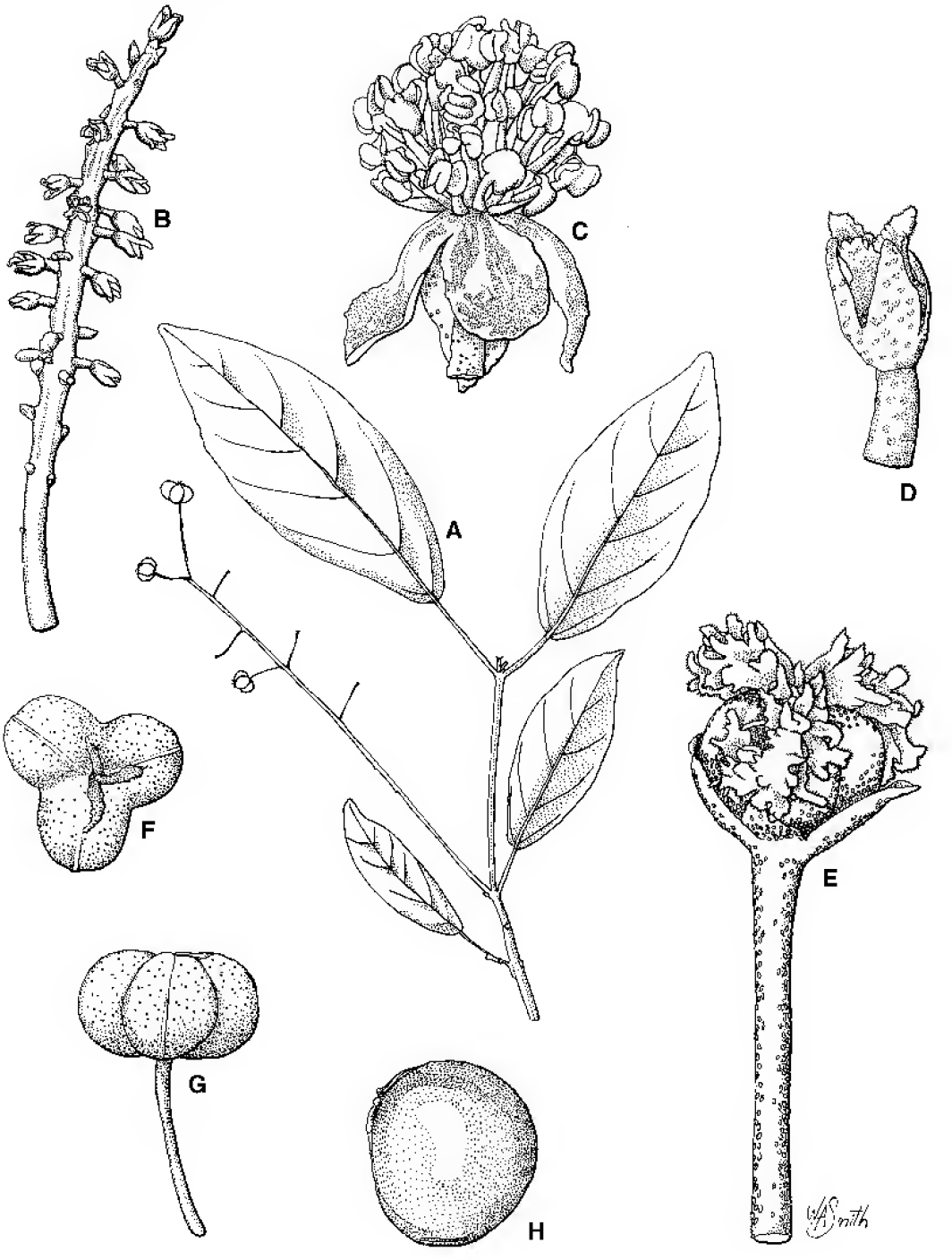


Fig. 9. ***Mallotus polyadenos***. A. fruiting twig. x 0.5. B. inflorescence. x 2. C. male flower. x 8. D. young female flower. x 8. E. older female flower. x 8. F. & G. fruit. x 3. H. seed. x 6. A, F-H from *Forster* 13090 (BRI); B-D. from *Neldner* 2856 (BRI); E from *Halford* Q735 (BRI). Del. W. Smith.

common. Not endangered or rare.

***Etymology*:** The specific epithet is derived from the Greek *poly* (many) and *odenos* (glands).

***Uses*:** None recorded.

11. Mallotus repandus (Willd.) Muell.Arg., Linnaea 34: 197 (1865); *Croton repandus* Willd., Neue Schrift. Naturf. Freunde Berlin 4: 206 (1803). **Type:** S India, *Klein* (holo: B n.v. [destroyed]).

Scrambling woody liane up to 20 m long; evergreen, perennial, monoecious. Stems ± rounded towards apices, with dense, clear stellate hairs and scattered yellow sessile glands when young, glabrescent. Stipules acute-lanceolate, 0.3–0.5 mm long, 0.2–0.3 mm wide, with dense yellow stellate hairs. Leaves alternate, not peltate, petiolate, discolorous; petioles 10–82 mm long, 0.6–1 mm diameter, with dense, yellow simple, biseriate and/or stellate hairs; basilaminar glands 1 or 2 per side of midrib near lamina base, ellipsoid, 0.3–0.4 mm long, 0.2–0.3 mm wide; lamina elliptic, broadly-ovate, ovate, 22–120 mm long, 15–90 mm wide; palminerved, comprising 2–4 lateral veins from base, 3–5 lateral veins further up midrib and reticulate interlateral veins; upper surface matt dark-green, lateral and interlateral veins just visible, without granular inclusions, glabrous, with dense, clear stellate hairs when young, becoming scattered with age; lower surface pale green to green-yellow, lateral and interlateral venation well developed, with dense, clear stellate hairs and scattered to sparse yellow sessile glands when young, becoming scattered with age; tip acute, short to long acuminate; base attenuate, weakly cordate, cuneate, rounded, truncate; margins sinuate to weakly dentate with up to 8 poorly developed teeth to 2 mm long. Inflorescences racemose or with 1 or 2 side branches, not paniculate, up to 180 mm long, with dense, clear stellate hairs; bracts lanceolate, c. 1 mm long and 0.3 mm wide, with dense, clear stellate hairs. Male flowers 1–10 per bract; pedicels 4–8 mm long, 0.5–0.8 mm diameter, with dense, yellow stellate hairs; calyx 3 or 4-lobed, lobes lanceolate-ovate to obovate, 2.5–4 mm long, 1.3–3.8 mm long, with dense, yellow stellate hairs and scattered yellow sessile glands; disk glands absent; stamens 74–88, free; filaments filiform, 2–2.5 mm long, c. 0.1 mm diameter, glabrous; anthers oblong, 0.5–0.6 mm long, 0.5–0.6 mm wide, glabrous, glandular cap absent. Female flowers 1 per bract; pedicels 1–8 mm long, 0.8–1 mm diameter, with dense, yellow stellate hairs; calyx 4-lobed, lobes lanceolate, 1.2–2.2 mm long, 0.6–0.9 mm wide, with dense, yellow stellate hairs; ovary 2-locular, subglobose, 1–3.8 mm long, 1.8–4 mm diameter, with dense, yellow stellate hairs, without echinate processes; styles 2, 1.8–4 mm long, connate at base for 0.5–0.8 mm, plumose, with dense yellow stellate hairs and scattered yellow sessile glands on backs. Fruits subglobose, 8–9 mm long, 11–15 mm diameter, with dense, yellow stellate hairs; without echinate processes. Seeds ovoid, 5–5.5 mm long, 4.5–5 mm wide, 4.5–5 mm thick, brown. Fig. 10.

***Selected additional specimens*: Queensland.** Coconut Bay, Lizard Island, 14°40'S, 145°28'E, Jul 1990, *Batianoff* 12223 (BRI); Kamerunga, Cairns, *Cowley* [AQ203989] (BRI); Claudie River, 12°45'S, 143°15'E, Oct 1972, *Dockrill* 547 (BRI, QRS); Lake Euramo, Oct 1976, *Dockrill* 1302 (BRI, CANB, QRS); 15 km along Ellison Beach, Oct 1937, *Flecker* N.Q.N.C. 3942 (QRS); Goldsborough road, 17°14'S, 145°46'E, Jan 1993, *Forster* PIF13091 & *Bean* (BRI, MEL, QRS); Isabella Falls area, McKinnon Creek, 4 km W of Edmonton, 17°02'S, 145°43'E, Jan 1993, *Forster* PIF13095 & *Bean* (BRI, MEL, QRS); Lamond Hill, Iron Range, 12°43'S, 143°17'E, Jul 1993, *Forster* PIF13581 et al. (BRI); Little Mulgrave River, 1 km below Gillies Highway Crossing, 17°08'S, 145°44'E, Sep 1989, *Gray* 5098 (QRS); Danbulla, c. 19 miles [31.7 km] SW of Cairns, 17°09'S, 145°43'E, Jul 1966, *Hyland* [AQ203990] (BRI); Scenic Reserve 440, Lake Euramo, 17°10'S, 145°40'E, Dec 1971, *Hyland* 5735 (BRI, QRS); S.F.R. 310, Goldsborough L.A., 17°15'S, 145°45'E, Jan 1978, *Hyland* 9632 (QRS); Cairns, Oct 1896, *Nugent* 20 (BRI); Long Scrub, Bamaga, 1962, *Webb & Tracey* 6936 (BRI); Galloways Creek, Bamaga, 1962, *Webb & Tracey* 7161 (BRI); Bloomfield River, *Webb & Tracey* 7733 (BRI); Shipton's Flat between Rossville & Mt Finnegan, 15°47'S, 145°14'E, May 1969, *Webb & Tracey* 9042 (BRI). Port Curtis District: S.F. 86, Eurimbula, 24°10'S, 151°50'E, Dec 1970, *Webb & Tracey* 10405 (BRI). Moreton District: Mt Eerwah, c. 4 km W of Eumundi, 26°29'S, 152°55'E, Dec 1987, *Sharpe* 4632 (BRI); cult. Coolum Beach (ex Mt Eerwah), Nov 1988, *Sharpe* 4750 (BRI).

***Distribution and habitat*:** In Australia *Mallotus repandus* occurs in the Cook, Port Curtis and Moreton districts of Queensland (Map 11). The southern populations are highly

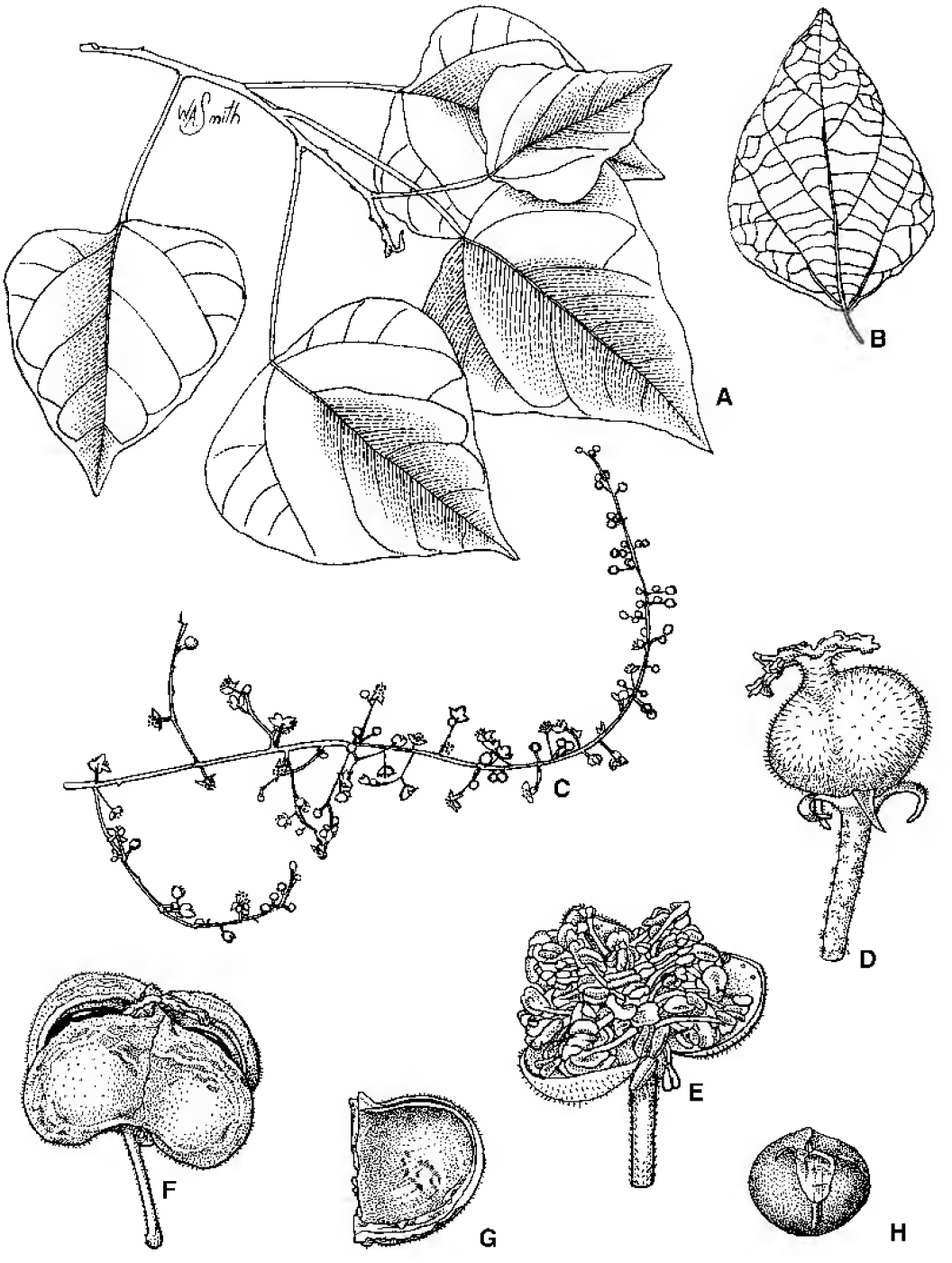


Fig. 10. ***Mallotus repandus***. A. twig. x 0.6. B. undersurface of leaf. x 0.6. D. female flower. x 4. E. male flower. x 6. F. fruit. x 3. G. section of dehisced fruit. x 3. H. seed. x 3. A, F, G, H from *Hyland* 9632 (QRS); B & C from *Forster* 18211 (BRI); E from *Gray* 5098 (QRS). Del. W. Smith.

disjunct. The species is also widespread in Malesia and Asia (Airy Shaw 1971, 1980c). Plants grow in notophyll vineforest on volcanic substrates.

***Phenology*:** Fertile collections are rare; however, flowering and fruiting probably occurs throughout the year.

***Notes*:** I have not been able to locate type material of this species; however, there seems little doubt as to the application of the name. A neotype from Indian material should be selected by a worker familiar with the genus in that area.

Airy Shaw (1981) noted that this species had been found near Bowen and Proserpine, but I have seen no specimens to confirm this.

***Etymology*:** The specific epithet is derived from Latin and refers to the sinuate leaf lamina margins.

***Uses*:** None recorded.

12. Mallotus resinosus (Blanco) Merr., Sp. Blanco. 222 (1918); *Adelia resinosa* Blanco, Fl. Filip. ed. 2: 562 (1845). **Type:** Philippines. LUZON: Batangas Province, Aug 1914, *Merrill* Species Blancoanae 485 (neo: US n.v., *fide* Merrill (1918: 222)).

Mallotus walkerae Hook.f., Fl. Brit. India 5: 437 (1887); *M. muricatus* var. *walkerae* (Hook.f) Pax & K.Hoffm. in Engl., Natur. Pflanzenfam. 7: 190 (1914). **Type:** Ceylon [Sri Lanka], *Walker* (holo: K n.v. [photo at BRI]).

Shrub or small tree to 5 m high; evergreen, perennial, dioecious. Stems ± rounded towards apices, with sparse, clear simple hairs and sparse yellow sessile glands when young, glabrescent with age. Stipules lanceolate, 2.2–4 mm long, 1.2–2 mm wide, with scattered, clear simple hairs. Leaves opposite, not peltate, petiolate, discolorous; petioles 1–15 mm long, 1.5–1.7 mm diameter, with sparse, clear simple hairs and sparse, yellow sessile glands; basilaminar glands 1 or 2 per side of midrib towards lamina base, ellipsoid, 0.5–1.2 mm long, 0.5–0.6 mm wide; lamina elliptic to obovate, 30–210 mm long, 15–110 mm wide; penninerved, comprising 11–12 lateral veins per side of midrib and reticulate interlateral veins; upper surface glossy dark-green, lateral and interlateral veins not visible, without granular inclusions, glabrous, with scattered, yellow sessile glands; lower surface pale green, lateral and interlateral venation well developed, glabrous, with sparse to dense yellow sessile glands; tip acute to short acuminate; base attenuate to cuneate; margins dentate with 8–14 teeth up to 3 mm long. Inflorescences racemose, up to 50 mm long, with sparse to dense, ginger simple, biseriate or rarely stellate hairs and dense yellow sessile glands; bracts triangular, 1.5–2.2 mm long, 1–1.2 mm wide, with sparse, clear simple hairs. Male flowers 1–3 per bract; pedicels 3–4.5 mm long, c. 0.4 mm diameter, with scattered to sparse, simple and/or biseriate hairs and scattered yellow sessile glands; calyx 2, 3 or 4-lobed, lobes obovate, 2.5–3 mm long, 1.2–2.4 mm long, with scattered, simple hairs and scattered yellow sessile glands; disk glands absent; stamens 26–48, free; filaments filiform, 2–3 mm long, c. 0.2 mm diameter, glabrous; anthers oblong, 0.5–0.6 mm long, 0.6–0.7 mm wide, glabrous, glandular cap absent. Female flowers 1 per bract; pedicels 1.5–5 mm long, 0.8–1 mm diameter, with sparse to dense, clear, simple and/or biseriate hairs and dense yellow sessile glands; calyx 4-lobed, lobes lanceolate, 2.8–3 mm long, 0.7–0.8 mm wide, with sparse simple hairs; ovary 3-locular, depressed-globose, c. 1.3 mm long, 1.8–2 mm diameter, with scattered, yellow stellate hairs, with dense, yellow sessile glands, with sparse echinate processes 0.5–1 mm long; styles 3, 2.6–3 mm long, connate at base for 0.7–1 mm, plumose, with scattered, yellow stellate hairs and scattered to sparse, yellow sessile glands on backs. Fruits depressed-globose, 5–7 mm long, 10-12 mm diameter, with scattered, yellow stellate hairs, with dense, yellow sessile glands and dense echinate processes 1.5–2 mm long. Seeds ovoid, c. 5 mm long, 4.5 mm wide, 4 mm thick, tan-brown. Fig. 11.

***Selected additional specimens*: Queensland.** COOK DISTRICT: Park Ranger Station, Claudie River, 12°36'S, 143°17'E, *Fell* DGF2089 (BRI); SE edge of Mt Cook, N.P. 142, on Quarantine Bay side, 15°29'S, 145°16'E, Feb 1992, *Fell* DGF2423 & *Jensen* (BRI); Mt Webb N.P., 15°04'S, 145°07'E, Dec 1992, *Fell* DGF2792 & *Stanton* (BRI, MEL, QRS), ditto, DGF2802 (BRI, MBA, QRS); Near Ginger Mick's Mine, 2 km S of

Fig. 11. ***Mallotus resinosus***. A. fruiting twig. x 0.5. B. inflorescence with male flowers. x 1. C. male flower. x 8. D. female flower. x 6. E & F. fruit. x 2. A, E & F from *Forster* 9527 (BRI); B & C. from *Forster* 14426 (BRI); D from *Hyland* 12443 (BRI). Del. W. Smith.

Punsand Bay, 10°44'S, 142°28'E, Feb 1990, *Forster* PIF6401 (BRI, DNA, QRS); Shiptons Flat, 10.5 km S of the Lions Den Hotel, Helenvale, 15°47'S, 145°14'E, Jan 1992, *Forster* PIF9527 (A, BRI, DNA, K, L, MEL, QRS); Round Mt, Embley Range, 13°33'S, 143°30'E, Jun 1992, *Forster* PIF10476 & *Tucker* (BRI, QRS); 1 km SE of the Twin Forks, headwaters of the Annan River, 15°49'S, 145°14'E, Jun 1992, *Forster* PIF10740 et al. (BRI, L, MEL, QRS); Shiptons Flat, 11.5 km from Lions Den Hotel, 15°47'S, 145°14'E, Dec 1993, *Forster* PIF14426 (A, BRI, MEL, QRS); Mt Augustus, Moa Island, 10°10'S, 142°18'E, Feb 1989, *Gray* 5003 (QRS); Altanmoui, 14°35'S, 144°35'E, Jul 1972, *Hyland* 6348 (BRI, QRS); Shiptons Flat on Tin Mine road, 15°45'S, 145°10'E, May 1969, *Smith* 14366 (BRI); Upper Cameron Creek, NW of Cooktown, 15°22'S, 145°07'E, Jul 1976, *Tracey* 14168 (BRI); Mt Webb, Starke Station, 15°03'S, 145°05'E, Sep 1974, *Tracey* 14407 (BRI); McIvor River Xing, Cooktown - Starke road, 15°07'S, 145°08'E, Jul 1976, *Tracey* 14428 (BRI); Dowlings Hill on Mt Amos road, S of Cooktown, 15°38'S, 145°18'E, Jun 1973, *Webb* & *Tracey* 11885 (BRI); Mt Stuckey area, inland from Starke Station,

14°56'S, 145°03'E, Sep 1974, *Webb & Tracey* 13807 (BRI); Lockerbie Scrub, 10°45'S, 142°30'E, *Webb & Tracey* 13808 (BRI); Between Starke & Hopevale, 15°12'S, 145°08'E, Sep 1974, *Webb & Tracey* 13809 (BRI).

***Distribution and habitat*:** *Mallotus resinosus* occurs in the Cook district of Queensland from Cape York south to the Annan River (Map 10) and is also widespread in Malesia (Airy Shaw 1971, 1976, 1981). Plants grow in notophyll or mesophyll semideciduous vineforest on substrates derived from granite or basalt.

***Phenology*:** Fertile collections are rare; plants flower from December to February and fruit several months later.

***Notes*:** There is no extant type material for this taxon and the representative specimen cited by Merrill (1918) may be considered a neotypification of the name (Balakrishnan & Chakrabarty 1991). Several other names were included in the synonymy of *Mallotus resinosus* by Balakrishnan & Chakrabarty (1991); however, I have not seen type material for these so bibliographic data is not included here. These authors considered that *Mallotus resinosus* is a polymorphic species with three varieties, with only the variety *resinosus* occurring in Australia.

In Australia *Mallotus resinosus* is superficially similar both to *Wetria australiensis* P.I.Forst. and *Alchornea rugosa* (Lour.) Muell.Arg.; however the two taxa may be easily distinguished by the alternate leaves, bifid styles and smooth fruit of the former (Forster 1994) and the foliage lacking sessile yellow glands of the latter.

***Conservation status*:** Widespread, not endangered or rare.

***Etymology*:** The specific name is derived from Latin and refers to *resin*. The application of this name remains obscure.

***Uses*:** None recorded.

13. Mallotus surculosus P.I.Forst., **sp. nov.** affinis *M. floribundo* (Blume) Muell.Arg. a qua in habitu frutice deciduo surculoso usque 3–5 mm alto, venis 8 vel 9 e basi radiantibus, stylis breviter connatis (0.5–1 mm) et partibus discretis brevioribus (2.5–3 mm), staminis paucioribus (18–20), et in fructu processis echinatis brevioribus (1–2.2 mm) differt. **Typus:** Queensland. Cook District: Shiptons Flat, 9 km from Lions Den Hotel, 15°46'S, 145°13'E, 10 Dec 1993, *P.I. Forster* PIF14420 (holo: BRI; iso: A, MEL, QRS).

Mallotus sp. aff. *mollissimus* #693 RFK; Hyland & Whiffin (1993).

Mallotus sp. (Claudie River P.I.Forster PIF135580; Forster & Henderson (1997).

***Illustration*:** Christophel & Hyland (1993: 109, t.47A)

Shrub to 5 m high, suckering profusely; seasonally deciduous, perennial, dioecious. Stems ± rounded towards apices, with sparse clear, simple or stellate hairs, glabrescent. Stipules lanceolate, 2.2–5 mm long, 0.8–1.3 mm wide, with sparse, clear stellate hairs. Leaves alternate, peltate, petiolate, discolorous; petioles 8–80 mm long, 1–1.3 mm diameter, with dense clear, simple, biseriate and/or stellate hairs and scattered yellow sessile glands; basilaminar glands 2 or 3 per side of midrib towards lamina base, ellipsoid to spherical, 0.7–0.8 mm long, 0.5–0.8 mm wide; lamina broadly-ovate to ovate, 20–130 mm long, 18–120 mm wide; palminerved, comprising 8–9 veins from the lamina base, 8–9 lateral veins per side of midrib and reticulate interlateral veins; upper surface matt grey-green, lateral veins barely visible, interlateral veins not visible, without granular inclusions, with sparse to dense, clear to ginger stellate hairs and scattered yellow sessile glands when young, becoming ± glabrescent with age; lower surface silver-green, lateral venation and interlateral venation well developed, with sparse to dense, clear to ginger simple, biseriate and/or stellate hairs and scattered to dense yellow sessile glands, indumentum persistent; tip short to long-acuminate; base rounded or truncate; margins weakly dentate with 16–20 small teeth to 1 mm long. Inflorescences racemose, up to 130 mm long, with sparse, clear simple, biseriate and/or stellate hairs and scattered yellow sessile glands; bracts triangular, 0.8–1.5 mm long, 0.7–1.2 mm wide, with dense, clear stellate

hairs. Male flowers 1–5 per bract; pedicels 1–2.5 mm long, c. 0.2 mm diameter, with dense clear stellate hairs; calyx 3- or 4-lobed, lobes lanceolate-ovate to obovate, 2–2.5 mm long, 1.3–1.6 mm long, with sparse to dense, clear stellate hairs; disk glands absent; stamens 18–20, free; filaments filiform, 1.3–1.8 mm long, c. 0.1 mm diameter, glabrous; anthers oblong, 0.7–0.8 mm long, 0.7–0.8 mm wide, glabrous or with an occasional simple hair, glandular cap absent. Female flowers 1 per bract; pedicels 1.2–5.5 mm long, 0.8–1 mm diameter, with dense, clear stellate hairs; calyx 4-lobed, lobes lanceolate, 3.5–4 mm long, 1–1.5 mm wide, with dense, clear stellate hairs; ovary 3-locular, subglobose, 1.8–2 mm long, 2.2–3 mm diameter, with scattered simple, biseriate and/or stellate hairs, scattered yellow sessile glands and dense echinate processes 1–1.2 mm long; styles 3(4), 2.5–3 mm long, connate at base for 0.5–1 mm, plumose with scattered simple hairs and scattered yellow sessile glands on backs. Fruits subglobose, 4.5–6 mm long, 7–9 mm diameter, with scattered simple, biseriate and/or stellate hairs, scattered yellow sessile glands and echinate processes 1–2.2 mm long. Seeds globose-ovoid, 3.8–4 mm long, 3–3.5 mm wide, 3.3–3.5 mm thick, tan-brown. Fig. 12.

***Specimens examined*: Queensland.** Cook District: West Claudie River Scrub, 12°44'S, 143°14'E, Jul 1993, *Forster* PIF13558 et al. (BRI); Massy Creek Crossing, Silver Plains, 13°55'S, 143°30'E, Jul 1993, *Forster* PIF13603 et al. (BRI, QRS); 3 km SSW of Rocky River Crossing, Silver Plains, 13°50'S, 143°27'E, Jul 1993, *Forster* PIF13646 et al. (BRI, QRS); West Claudie River, 12°45'S, 143°15'E, Jun 1972, *Hyland* 6188 (QRS); T.R. 14 Massy, 13°52'S, 143°25'E, Nov 1980, *Hyland* 10861 (QRS); Claudie River, 12°44'S, 143°14'E, Oct 1981, *Hyland* 11224 (QRS); Claudie River, 12°43'S, 143°16'E, Jan 1982, *Hyland* 11505 (QRS); T.R. 176 Monkhouse, Annan River, 15°45'S, 145°13'E, Sep 1982, *Hyland* 11997 (QRS); ditto, Oct 1982, *Hyland* 12163 (QRS); T.R. 176, Shipton L.A., 15°48'S, 145°14'E, Sep 1982, *Hyland* 12061 (QRS); S.F.R. 176, Parish of Monkhouse, 15°47'S, 145°16'E, Dec 1988, *Hyland* 13775 (BRI, QRS); Near Porn. 37V Parish of Monkhouse, 15°48'S, 145°14'E, Dec 1988, *Hyland* 13776 (QRS).

***Distribution and habitat*:** *Mallotus surculosus* is restricted to north-east Queensland from the Claudie River in the north to Shipton's Flat south of Cooktown (Map 6). Plants grow on alluvium or stony hillsides, always on the margins of notophyll or mesophyll vineforest. Plants sucker profusely and form dense monospecific thickets.

***Notes*:** *Mallotus surculosus* was first collected by Hyland in 1972; however, fertile material was not obtained until the late 1980's. The species is not mentioned by Airy Shaw (1981). Although labelled as "sp. aff. mollissimus" by Hyland & Whiffin (1993), *Mallotus surculosus* appears to be most closely related to *M. floribundus* (Blume) Muell.Arg. from New Guinea. *Mallotus surculosus* differs from *M. floribundus* in being a seasonally deciduous, suckering shrub, 3–5 m high; having 8 or 9 veins radiating from the leaf lamina base; the styles shortly connate (0.5–1 mm long) and the free parts shorter (2.5–3 mm long); fewer stamens (18–20); and shorter echinate processes on the fruit (1–2.2 mm long). *M. floribundus* is an evergreen, non-suckering tree, 7–13 m high, usually growing on the edge of freshwater swamps or streams and has 4–6 veins radiating from the leaf lamina base; the styles long-connate (1.5–3 mm) with the free parts longer (5–9 mm); more stamens (36–56); and longer echinate processes on the fruit (3–4 mm long).

***Phenology*:** Flowers December to January; fruits January to March. Plants flower when ± leafless. The fruit are shed before the foliage is fully expanded.

***Conservation status*:** Uncommon throughout its known range. Present in Iron Range National Park and Daintree National Park. Not considered rare or threatened.

***Etymology*:** The specific epithet is derived from the Latin *surculosus* (suckering) and alludes to the dense suckering habit of this species.

***Uses*:** None recorded.

Excluded names and species

1. Mallotus tiliifolius (Blume) Muell.Arg., Linnaea 34: 190 (1865); *Rottlera tiliifolia* Blume, Bidjr. 607 (1825). **Type:** Java. [ad littora insularum Nusae Kambangae et Javae], *Blume* s.n. (holo: BO).

***Notes*:** Airy Shaw (1981) applied this name to collections from Prince of Wales Island and Trinity Beach near Cairns. The former is a

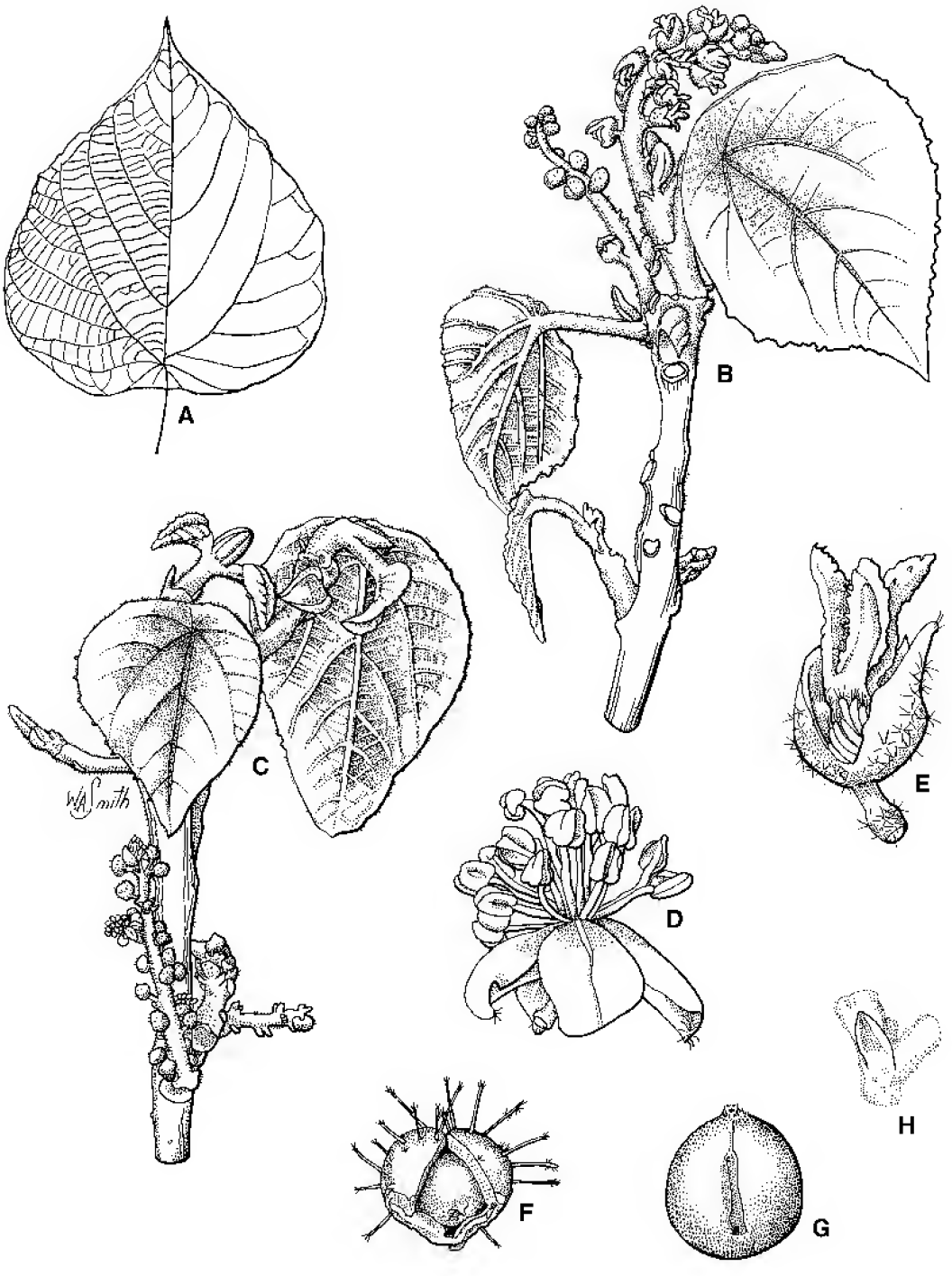


Fig. 12. ***Mallotus surculosus***. A. undersurface of mature leaf. x 0.5. B & C. flowering twigs with immature foliage. x 1.5. D. male flower. x 8. E. female flower. x 8. F. third of dehisced fruit showing stalked hairs. x 4. G. seed. x 8. H. internode showing stipule. x 2. A,B,D,E,H from *Forster* 14420 (BRI); C from *Forster* 16990 (BRI); F,G from *Hyland* 11505 (BRI). Del. W.Smith.

specimen of *Mallotus paniculatus* and the latter is a specimen of *M. nesophilus*. *Mallotus tiliifolius* does not occur in Australia.

I located a single sheet at BO that is probably the type of *R. tiliifolia*. This sheet bears a printed label that says "Java" and bears the name "Mallotus tiliifolius Muell.Arg." in Blume's handwriting. The specimen and label have been remounted, so there is no accompanying BO sheet number.

2. Mallotus derbyensis W.Fitzg., J. Roy. Soc. W. Aust. 3: 165 (1918).

***Notes*:** This name was referred to the synonymy of **Grewia breviflora** Benth. (Tiliaceae) by Airy Shaw (1981) and this remains unchanged (D. Halford, pers. comm. 1993).

3. Mallotus oblongifolius (Miq.) Muell.Arg., Linnaea 34: 187 (1865); *Rottlera oblongifolia* Miq., Fl. Ind. Bat.1(2: 396 (1859).

***Notes*:** Airy Shaw (1976, 1981) based his record of this species for Australia on a sterile specimen collected by *Berthoud* at the Johnstone River. This specimen (MEL69850) is *Macaranga inamoena* F.Muell.

Acknowledgements

W. Smith (BRI) provided the excellent figures. Field collections were made over what now seems a long time, with the assistance on occasion of A.R. Bean, L.H. Bird, G. Kenning, D. & I. Liddle, D. Orford, G. & N. Sankowsky, P.R. Sharpe, G. Smyrell and M.C. Tucker. Translation of the diagnoses into Latin was undertaken by L.A. Craven (CANB). Resolution of typification for the name *M. polyadenos* was made with the assistance of J.H.Ross (MEL). Access to State Forests and Timber Reserves in Queensland were facilitated by permits issued by the Queensland Forest Service. Photographs of type specimens at BM and K were arranged by P.S. Short (MEL) while Australian Botanical Liaison Officer at Kew (U.K.). Assistance with the visit to BO was ably provided by D.J. Liddle in February 1992. This work was a preferred objective of the Australian Biological Resources Study which funded the project during 1992-1994.

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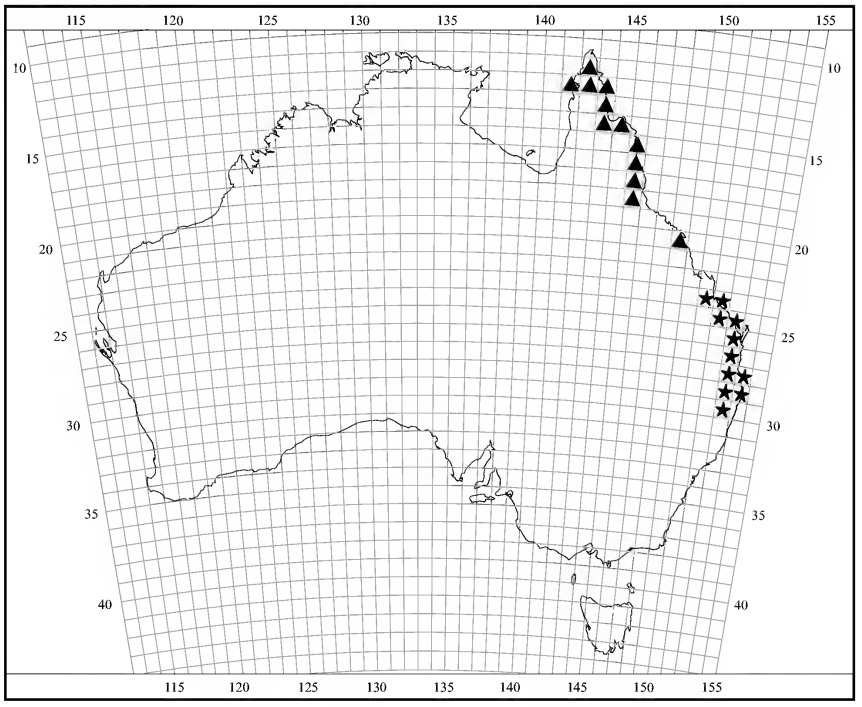
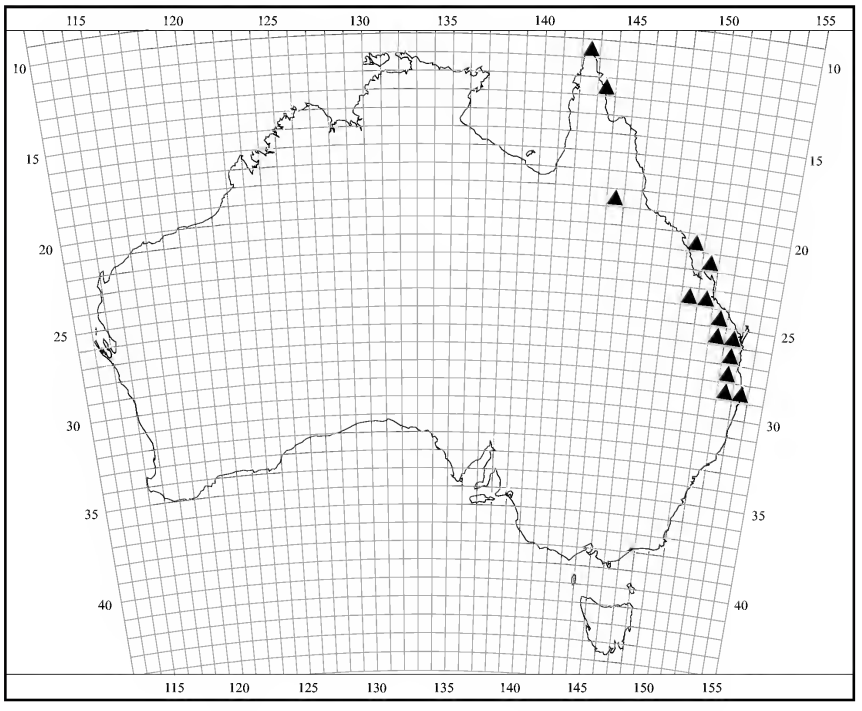
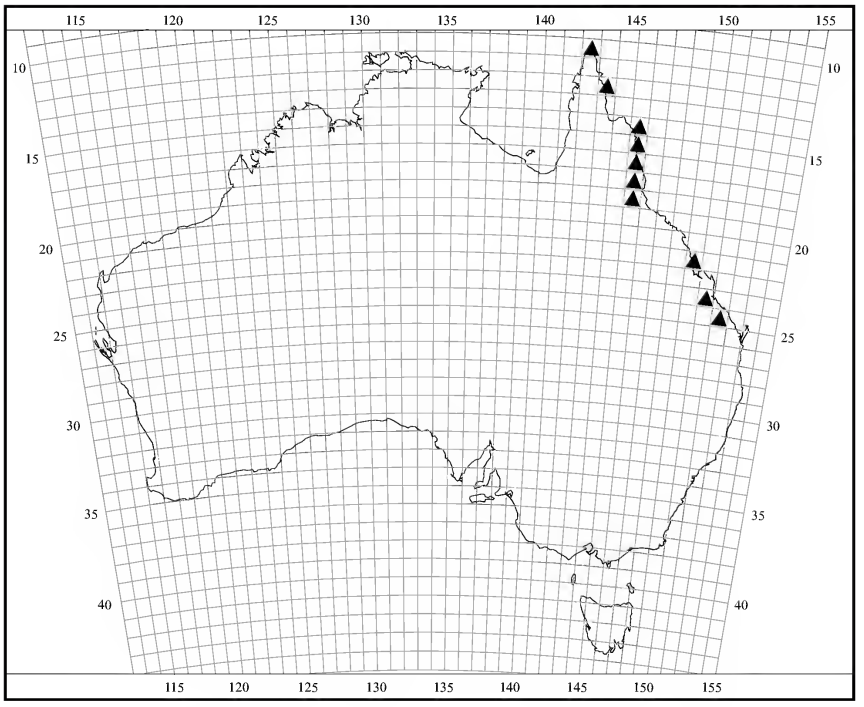


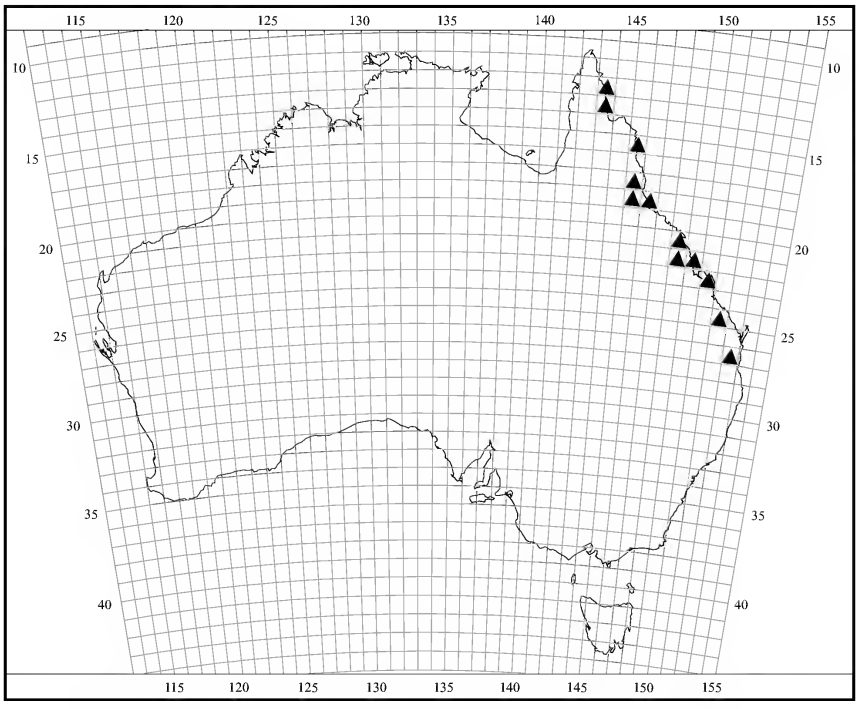
Map 2. Distribution of ★ *Mallotus discolor*, ▲ *Mallotus polyadenos*.



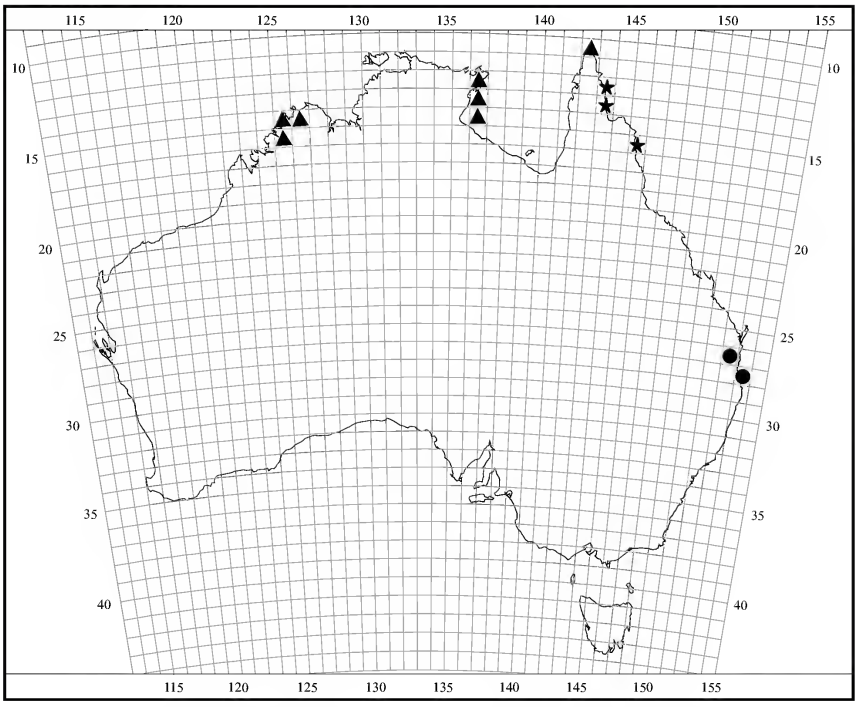
Map 3. Distribution of ▲ *Mallotus claoxyloides*.



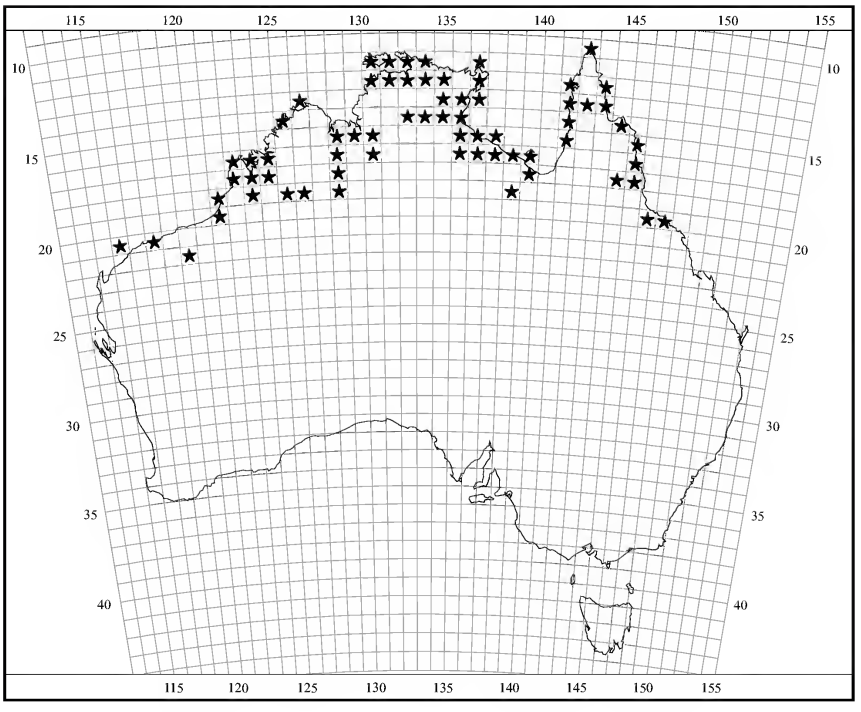
Map 4. Distribution of ▲ *Mallotus ficifolius*.



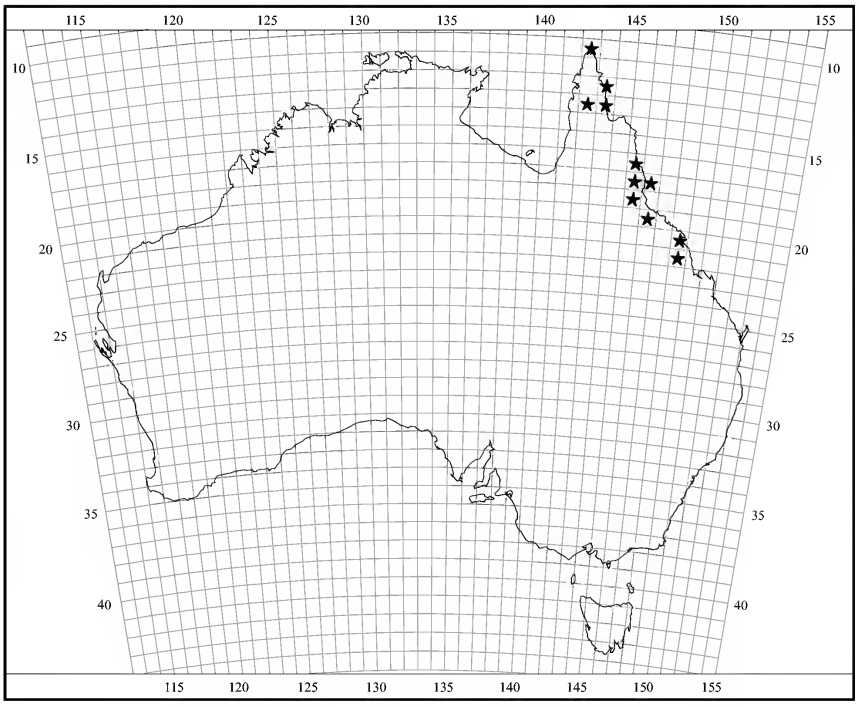
Map 5. Distribution of ▲ *Mallotus mollissimus*.



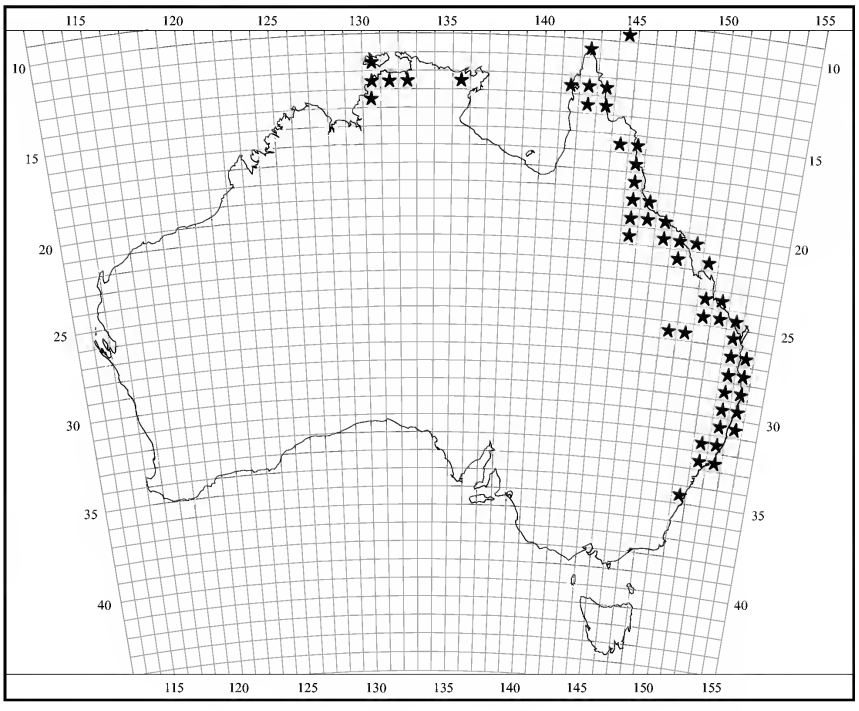
Map 6. Distribution of ▲ *Mallotus dispersus*, ★ *Mallotus surculosus*, ● *Mallotus megadontus*.



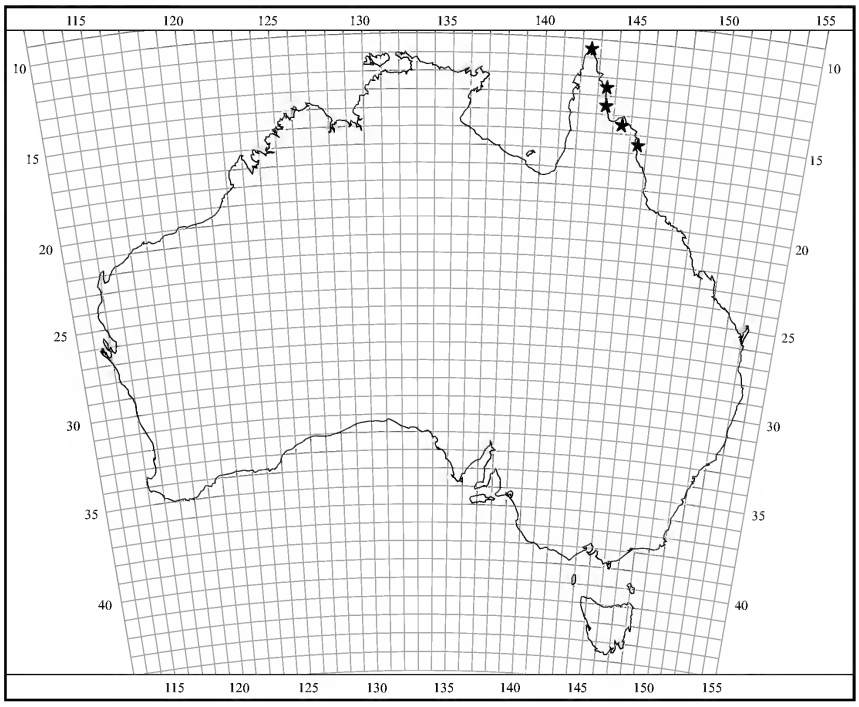
Map 7. Distribution of ★ *Mallotus nesophilus*.



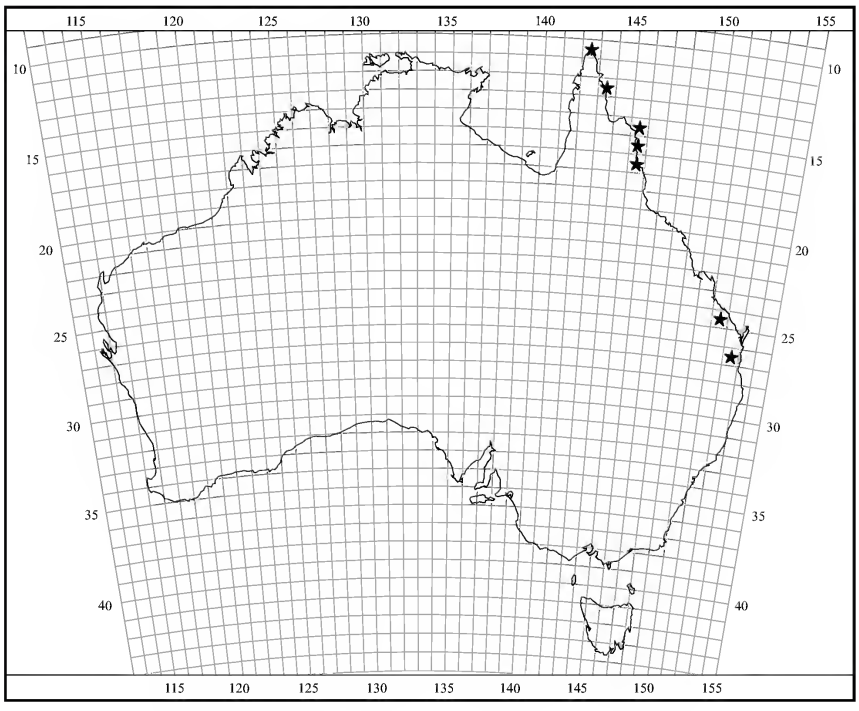
Map 8. Distribution of ★ *Mallotus paniculatus*.



Map 9. Distribution of ★ *Mallotus philippensis*.



Map 10. Distribution of ★ *Mallotus resinosus*.



Map 11. Distribution of ★ *Mallotus repandus*.

Ochrosperma obovatum (Myrtaceae), a new species from south-eastern Queensland

A.R. Bean

Summary

Bean, A.R. (1999). *Ochrosperma obovatum* (Myrtaceae), a new species from south-eastern Queensland. *Austrobaileya* 5(3): 499-501. A new species of *Ochrosperma* is described and illustrated, with notes on habitat and conservation status. A revised key to the species of *Ochrosperma* is provided.

Keywords: *Ochrosperma, Baeckea*, Myrtaceae, taxonomy, key, Australian flora

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Introduction

The genus *Ochrosperma* was established by Trudgen (1987). Some of its species were previously included under *Baeckea* L. It is characterised by a 3-locular ovary with 2 collateral ovules per loculus, reniform arillate seeds and few antesepalous stamens (generally 5, but sometimes up to 8).

Continuing botanical exploration in south-eastern Queensland has revealed a new species of *Ochrosperma*, bringing the total number of species to six. *Ochrosperma* has an unusual phytogeography. *O. lineare* and *O. citriodorum* occur in coastal heathland of southern Queensland and northern New South Wales. *O. sulcatum* occurs on a sandstone cliff-face in the Northern Territory (Bean 1997). *O. adpressum* and *O. oligomerum* grow in heath or heathy woodland communities, the former in central Queensland and the latter in central New South Wales (Bean 1995). The new species also grows in heathland in inland parts of south-east Queensland. It forms a geographical link between the coastal species and the more inland *O. adpressum*.

Taxonomy

Ochrosperma obovatum A.R.Bean **sp. nov.** affinis *O. lineari* autem foliis obovatis usque oblanceolatis, 1-1.8 mm latis (linearibus, 0.5-1 mm latis in *O. lineari*), floribus 3.5-4.5 mm diam. (2.5-3.5 mm diam.in *O. lineari*), inflorescentibus 1-3-floris (1- vel 2-floris in *O. lineari*) differt. **Typus**: Queensland. Burnett District: State Forest 132, c. 6 km ESE of Brovinia, south of Mundubbera, 9 November 1997, *A.R. Bean* 12564 (holo: BRI (1 sheet + spirit); iso: CANB, MEL, NSW, PERTH).

Shrub 50–80 cm tall. Bark grey, scaly, persistent. Branchlets grey, terete, eglandular or sparsely glandular. Leaves overlapping, decussate; laminae obovate to oblanceolate, straight, plano-convex, 2.7–4.5 x 1.0–1.8 mm, margins entire, apex obtuse; oil glands small, rather obscure; petioles 0.4–0.7 mm long. Inflorescences axillary, 1–3-flowered; peduncles extremely short; pedicels 0.6–1.2 mm long; bracteoles 2, persistent to anthesis, broadly ovate, 0.7–0.8 x 0.3–0.6 mm, obtuse or acute, cymbiform. Hypanthium broadly campanulate, 1.5–1.8 mm long, 2.8–3.0 mm wide, surface smooth or muriculate, without ribs. Sepals lunate to semi-orbicular, translucent, 0.3–0.7 x 1.0–1.2 mm, with thickened midrib, margins entire or denticulate, oil glands present. Corolla white, 3.5–4.5 mm across; petals broadly obovate to orbicular, 0.9–1.3 x 1.2–1.8 mm, margins entire or minutely fimbriate, oil glands present. Stamens 5 (–6), antesepalous; filaments slightly flattened, 0.6–0.8 mm long; anthers versatile, dorsifixed, c. 0.4 mm long, dehiscing by longitudinal slits; connective

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gland dark brown to black, globular, in diameter about one-third the length of the anthers. Style terete, very short at anthesis, but reaching c. 0.8 mm long after anthesis; stigma capitate. Ovary 3-locular, ovules 2 per loculus, collateral. Fruit broadly campanulate, 1.4–1.8 x 3.0–3.4 mm, valves somewhat woody, conspicuous, not spreading widely on dehiscence. Seeds turgid, reniform, papillose, c. 1.5 mm long, pale yellow in colour, with a small white aril overlying the hilum. Fig. 1.

***Additional specimens examined*: Queensland.** BURNETT DISTRICT: S.F. 132, c. 6 km ESE of Brovinia, Jun 1997, *Bean* 12044 (BRI, MEL, NSW). LEICHHARDT DISTRICT: just east of Planet Creek, "Planet Downs", E of Rolleston, Oct 1998, *Bean* 14219 (BRI).

***Distribution and habitat*:** *O. obovatum* is known from two populations about 250 km apart. At the type locality, it occurs over an area of about 5 hectares, in a treeless heathland which has formed on a relictual Tertiary surface, heavily lateritised. The most common associated species are *Acacia julifera* Benth. subsp. *julifera, Triodia scariosa* N.T.Burb., *Babingtonia densifolia* (Sm.) F.Muell., *Hibbertia exutiacies* N.A.Wakef. and *Melaleuca thymifolia* Sm. The surface soil is sandy. Nearby trees include *Eucalyptus tenuipes* (Maiden & Blakely) Blakely & C.T.White and *E. watsoniana* F.Muell. subsp. *watsoniana*. At Planet Downs, it occurs in heathland on sandstone pavement with *Leptospermum sericatum* Lindl. and *Dodonaea* spp. Altitude range is 320–360 metres.

***Phenology*:** Poorly known; it probably flowers in response to rainfall.

***Affinities*:** *Ochrosperma obovatum* differs from *O. lineare* by the obovate leaves 1–1.8 mm wide (linear, 0.5–1 mm wide in *O. lineare*), flowers 3.5–4.5 mm in diameter (2.5–3.5 mm diameter for *O. lineare*) and inflorescence often 3-flowered (1- or 2- flowered in *O. lineare*)

O. obovatum differs from *O. citriodorum* by the seeds c. 1.5 mm long (0.9–1.1 mm long for *O. citriodorum*), non-lemon scented leaves (lemon scented for *O. citriodorum*), and the 1–3-flowered inflorescences (1- flowered for *O. citriodorum*).

***Conservation status*:** The recommended status is Vulnerable, using the IUCN Red List Categories (criterion D). There are two known populations. The type population comprises 250-500 plants. Part of the population lies within State Forest 132, while part lies on adjacent freehold or leasehold land. The only recent disturbance has been fence and track construction along the boundary of the State Forest. The second population comprises about 100 plants.

***Etymology*:** The species epithet refers to the obovate leaf shape possessed by the species. This is in contrast to other *Ochrosperma* species occurring in Queensland.

Key to the species of *Ochrosperma*

1. Leaves obovate or elliptical, 2–3 times longer than wide 2
   Leaves linear to narrowly lanceolate, 5–12 times longer than wide 4

2. Leaves elliptical, 1.6–2.2 mm wide; petals 1.8–2.2 mm long ..... **O. oligomerum**
   Leaves obovate, 0.8–1.8 mm wide; petals 0.8–1.3 mm long 3

3. Leaves lemon-scented; seeds 0.9–1.1 mm long ..... **O. citriodorum**
   Leaves not lemon-scented; seeds c. 1.5 mm long ..... **O. obovatum**

4. Stamens 6–8 per flower; fruits 3.3–4.0 mm wide; leaves markedly 4-ranked... **O. adpressum**
   Stamens 5 per flower; fruits 1.5–2.7 mm wide; leaves not markedly 4-ranked 4

5. Calyx lobes acuminate, rigid, 1.0–1.3 mm long ..... **O. sulcatum**
   Calyx lobes obtuse, soft, 0.3–0.5 mm long ..... **O. lineare**

Acknowledgements

I am grateful for the support of Martin Ambrose and Trevor Ritchie (Queensland Department of Natural Resources). Will Smith (BRI) provided the illustrations, and Les Pedley the Latin diagnosis.

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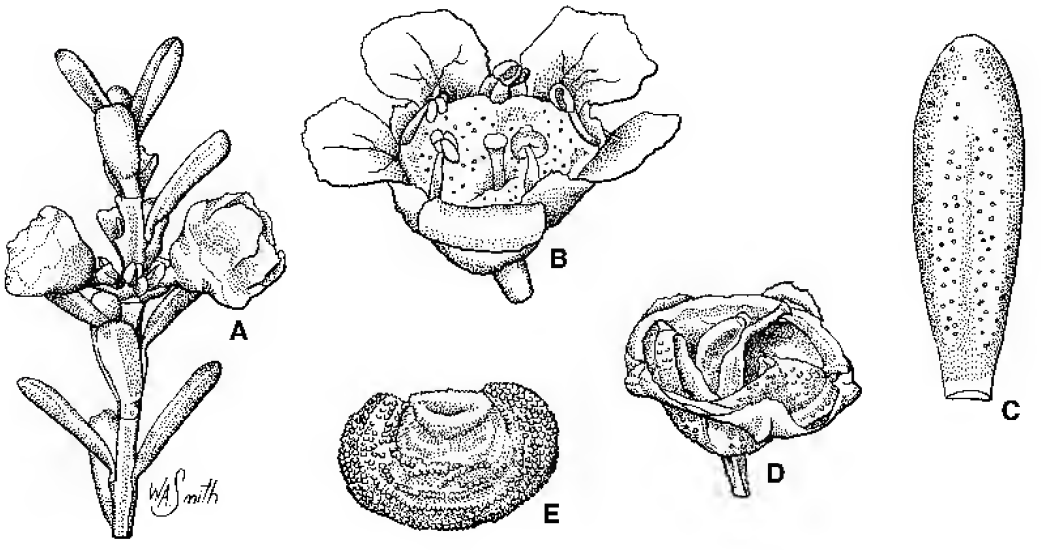
TRUDGEN, M.E. (1987). *Ochrosperma*, a new genus of Myrtaceae (Leptospermeae, Baeckeinae) from New South Wales and Queensland. *Nuytsia* 6: 9-17.

Fig 1. *Ochrosperma obovatum*. A. branchlet with inflorescence x 5. B. flower x 10. C. leaf x 10. D. fruit x 10. E. seed x 20, showing aril and minutely tuberculate surface. A-B, *Bean* 12564; C-E, *Bean* 12044.



A revision of *Chrysopogon* Trin. including *Vetiveria* Bory (Poaceae) in Thailand and Malesia with notes on some other species from Africa and Australia

J.F. Veldkamp

Summary

Veldkamp, J.F. (1999). A revision of *Chrysopogon* Trin. including *Vetiveria* Bory (Gramineae) in Thailand and Malesia with notes on some other species from Africa and Australia. *Austrobaileya* 5(3): 503-533. *Vetiveria* Bory (Gramineae) is reduced to *Chrysopogon* Trin. resulting in 5 new combinations and the validation of 1 in *Capillipedium*. In Thailand there are 11 species (1 new) of *Chrysopogon* and in Malesia 13 species (3 new).

Keywords: Taxonomy, Poaceae, *Chrysopogon*, *Vetiveria*

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Introduction

Traditionally, *Chrysopogon* Trin. and *Vetiveria* Bory have been regarded as distinct entities, either as subgroups of *Andropogon* L., or as related, but distinct genera. Yet, one finds occasional remarks about the presence of intermediary species. That Roberty (1960) merged the two into *Chrysopogon* has not been followed or remarked upon by subsequent authors, probably because of the general aversion to his methodology and resulting system. The close relationship between the two genera was already observed by Hackel (1889: 542), who said that the two were hardly distinct, as they are united by intermediary species, and suggested that *Chrysopogon* might be derived from *Vetiveria* (l.c., t. 2).

Keng (1939: 314) noted that 'There is such a close affinity between *Rhaphis* Lour. (for *Chrysopogon*) and *Anatherum* Beauv. (for *Vetiveria*) that the intermediate forms, *Anatherum fulvibarbe* (Trin.) Keng and *Rhaphis elongatus* (R. Br.) Chase var. *filipes* (Benth.) Keng might be referred to either genus'. He defined *Chrysopogon* arbitrarily as having 1- or 2-jointed racemes and an acute to pungent callus, but remarked again that 'there are all stages of reduction from multi-joined racemes and of elongation of the obtuse callus in ... (*Vetiveria*) ... to the 1-jointed racemes of 3 spikelets ('triad') and to a pungent callus as in most species of ... (*Chrysopogon*)'. Blake (1944: 21) stated 'There is nothing in the structure of the spikelets to separate the genera, but the facies of the two is rather different', and so kept them apart. What these different facies are, is not explained.

Clayton & Renvoize (1986: 342) wrote: '*Chrysopogon* intergrades with *Vetiveria* via *C. sylvaticus*, and the separation of these genera is somewhat arbitrary, particularly in Australia. It is marginally justified by the convenience of treating the compact cluster of species with triads as a single entity'. And also, '*Vetiveria* ... *pauciflora*, with only 2 or 3 spikelet pairs per raceme, links (*Vetiveria*) to *Chrysopogon*.'

Among the Australian (and some Malesian) species included in *Vetiveria* by Blake (1944; followed by Simon 1993) there are some with well-developed inflorescences that have both the single triad of spikelets ('typical' for *Chrysopogon*) and the inflorescence branch with several joints ('typical' for *Vetiveria*):

V. elongata (R. Br.) C.E. Hubb. has (1–)3–6 pairs, *V. filipes* (Benth.) C.E. Hubb. (incl. *V.*

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intermedia S.T. Blake) (1–)3–7, and *V. pauciflora* S.T. Blake (1 or) 2 or 3.

On the other hand Blake accepted in *Chrysopogon C. fallax* S.T. Blake as '1-jointed or very rarely ... 2-jointed', *C. latifolius* S.T. Blake as '1-jointed or rarely 2-jointed', and *C. sylvaticus* C.E. Hubb. with '(well-developed) racemes usually 2-, but frequently 1- or 3-jointed', exhibiting the same states as found in his *Vetiveria* species.

A study of additional species from Asia and Africa showed a similar variability of the number of joints. Other differentiating characters sometimes mentioned are that *Vetiveria* would have a glabrous callus [it is usually at least setulose, even in *V. zizanioides* (L.) Nash], and an enclosed to shortly exserted, straight awn with a glabrous column. These characters, as distinguishing attributes, break down, too:

Chrysopogon argutus (Steud.) Trin. ex Jackson, from Mauritius and Rodriguez, has 1–6 spikelet groups per branch, a pungent, hairy callus, and a long-exserted more or less straight awn with a puberulous column.

Chrysopogon celebicus Veldk., from Celebes, has 4–7 spikelet groups, a rounded to oblique, but obtuse callus with long hairs, a well-developed straight to geniculate awn with a puberulous column.

Chrysopogon elongatus (R. Br.) Benth., from Australia, has (1–)3–6 spikelet groups, an oblique, pungent, hairy callus, and an enclosed to exserted, straight awn with a glabrous column.

Chrysopogon filipes (Benth.) Reeder from Australia and New Guinea has 1–7 spikelet groups, an oblique, pungent, hairy callus, and an exserted, straight awn with a puberulous column.

Chrysopogon fulvibarbis (Trin.) Veldk. from W. Africa has up to 6 spikelet groups, an oblique, pungent, hairy callus, and an exserted, geniculate awn with a puberulous column.

Chrysopogon gryllus subsp. *echinulatus* (Nees) Cope (1980) has 2 or 3, and occasionally even 5 spikelet groups, while subsp. *gryllus* has triads only. Cope (1982) remarked that there is a gradual transition between the two along the Himalayan belt with an intermediary population in the Nilgiris in S. India. Accepting the distinction between the genera outlined above, the two subspecies would have to be divided over both genera! It may be noted that Roberty (1960) has this as a variety of *C. zizanioides*; as usual his taxonomy is most remarkable. Both forms have an oblique, pungent, hairy callus and an exserted, geniculate awn with a puberulous column.

Chrysopogon intercedens Veldk. from New Guinea has 2 or 3 spikelet groups, an oblique, pungent, hairy callus, and an exserted, straight awn with a puberulous column.

Chrysopogon lawsonii (Hook.f.) Veldk. from India and Thailand has 2–8 spikelet groups, an oblique, but rather obtuse distinctly hairy callus, and an exserted, geniculate awn with a puberulous column.

Chrysopogon micrantherus Veldk., from New Guinea, has 1–3 spikelet groups, an oblique, pungent, hairy callus, and an exserted, geniculate awn with a puberulous column.

Chrysopogon nemoralis (Balansa) Holttum, a very rare species with a disjunct distribution in the Malay Peninsula, Vietnam, and the Philippines, has 1–3 spikelet groups per branch, an oblique, pungent, hairy callus, and an exserted, straight awn with a puberulous column.

Chrysopogon nodulibarbis (Steud.) Henr. from S. India and Sri Lanka has up to 3 spikelet groups, an oblique, pungent, hairy callus, and an exserted, geniculate awn with a puberulous column. Bor (1960) used *C. zeylanicus* (Steud.) Thw. for this, but the choice between the equally old epithets had already been made by Hackel (1889: 554).

Chrysopogon oliganthus Veldk. based on *V. pauciflora* S.T. Blake from Australia has 1–3 spikelet groups per branch, an oblique, pungent, hairy callus, and an exserted, straight awn with a puberulous column.

Chrysopogon rigidus (B.K. Simon) Veldk. from Australia has 3–5 spikelet groups

per branch, an oblique, pungent, hairy callus, and an exserted, straight awn with a puberulous column.

Chrysopogon setifolius Stapf from Australia has 1–3 spikelet groups per branch, an oblique, obtuse, hairy callus, and no awns.

Chrysopogon sylvaticus C.E. Hubb. from Australia has 1–4 spikelet groups per branch, an oblique, pungent, hairy callus, and an exserted, geniculate awn with a puberulous column.

So, there is a gradual transition from *Vetiveria* to *Chrysopogon*, and it is not possible to maintain *Vetiveria* for even its type species, *V. zizanioides*, and its two very close relatives, *V. festucoides* (Presl) Ohwi and *V. nigritana* (Benth.) Stapf.

Celarier (1959) considered *V. zizanioides* 'as the most primitive and possibly the ancestral form' of *Chrysopogon* because of the transverse articulation of the several-noded partial inflorescences with well-developed pedicelled spikelets, and a short and obtuse, glabrous to setulose callus. If correct, *Vetiveria* would be the sister group of *Chrysopogon*, and I tried to find a suitable outgroup for the two using Watson & Dallwitz's (1996) 'Grass genera of the world' for DELTA with a modified version of the identification program Intkey (vs. 3.18) (see Dallwitz 1980; Dallwitz et al. 1993; Watson et al. 1986). *Sorghum* Pers. appeared to be the most similar (but not necessarily most closely related!) taxon. This agrees with Clayton & Renvoize's (1986) suggestion that *Sorghum* and especially *Sorghum* subgen. *Parasorghum* (Snowden) Garber would be the closest relative. However, the species of the latter have hairy culm nodes which have, so far, not been seen by me in any species of *Chrysopogon* or *Vetiveria*. Ho (1993) depicted hairy nodes for a species from Vietnam he called *C. lawsonii*, but which otherwise seems very similar to *C. festucoides* (Presl) Veldk.

Recently, a RAPDs study was made by Adams et al. (1998) of the relationships primarily between the cultivated races of *V. zizanioides* with some species of *Chrysopogon*, *Sorghum*, and *Vetiveria* added for comparison. The results support the idea of a single genus, as at least *C. fulvus* (Spreng.) Chiov. and *C. gryllus* (L.) Trin. appear to be less similar to each other than to the *Vetiveria zizanioides* cluster, while *V. elongata* (R. Br.) C.E. Hubb. and *V. filipes* (Benth.) C.E. Hubb. are very close to that cluster.

Vetiveria zizanioides is of some importance as a source of aromatic oils ('vetiver oil' and 'oil of vetiver roots'), and has lately been widely proposed as a very promising soil-binder (Nat. Res. Council 1993), so this name doubtlessly will continue to be widely used with the usual complaints about taxonomists always changing names. Unfortunately, science means progress, and progress means changes, and no list of 'Names in Current Use', as proposed by some, will or should stop that. Pulle (1952) remarked that 'nomenclatural stability will only be reached when scientific taxonomy has been murdered and buried'.

Proposing conservation of *Vetiveria* over *Chrysopogon* seems doomed to fail, as a far greater number of new combinations would then be required, and the latter is already conserved over three others.

Chrysopogon sometimes is divided into informal groups based on the relative length of the pedicel (distinctly less than half as long as the sessile spikelet vs. more than half as long) and whether it is setose or glabrous. The relative length is in most cases a useful character, but there are exceptions, as in *C. oliganthus* and *C. rigidus*, where the length of the pedicel ranges from very short to distinctly more than half the length of the sessile spikelet in the same inflorescence.

Chrysopogon borneensis Henr. and *C. tenuiculmis* Henr. are very similar, differing for instance by the presence of hairs on the pedicel, but placement of them in different groups would seem strange in view of their overall similarity and provenance! In some cases, it appears as if the anthers of the sessile spikelets are staminodial, for instance in *C. aciculatus* (Retz.) Trin. (sometimes) and in *C. intercedens*. Two anthers in the sessile spikelet have been seen in some florets of *C. subtilis* (Steud.) Miq. and *C. tadulingamii* Sreekumar.

Taxonomy

Chrysopogon Trin., Fund. Agrost. (1820) 187, nom. cons.; Phoenix Haller, Hist. Stirp. Helv. 2 (1768) 202, nom. superfl., non L. (1753); *Pollinia* Spreng., Pl. Min. Cogn. Pug. 2 (1815) 10, nom. rej.; *Andropogon* subgen. *Chrysopogon* (Trin.) Hack., Mon. Androp. (1889) 547; *Chalcoelytrum* Lunell, Am. Midl. Nat. 4 (1915) 212, nom. superfl. **Type:** *C. gryllus* (L.) Trin. [Lecto, fide Pfeiffer, Nomencl. Bot. 1 (1873) 745; ICBN (1994) 185].

Rhaphis Lour., Fl. Cochinch. (1790) 538, 552, nom. rej.; *Chrysopogon* sect. *Rhaphis* (Lour.) Roberty, Boissiera 9 (1960) 282, 289. **Type:** *R. trivialis* Lour., nom. superfl. [= *Chrysopogon aciculatus* (Retz.) Trin.]

Centrophorum Trin., Fund. Agrost. (1820) 106, t. 5, nom. rej. **Type:** *C. chinense* Trin. [= *Chrysopogon aciculatus* (Retz.) Trin.]

Vetiveria Bory in Lemaire, Bull. Sc. Soc. Philom. (1822) 43; *Andropogon* L. sect. *Vetiveria* (Bory) Thouars ex Benth., J. Linn. Soc. 19 (1881) 72; *Andropogon* L. subgen. *Vetiveria* (Bory) Benth. ex Hack., Mon. Androp. (1889) 542; *Chrysopogon* sect. *Vetiveria* (Bory) Roberty, Bull. Inst. Franç. Afr. Noire 22 (January 1960) 106, nom. inval.; Boissiera 9 (July 1960) 291. **Type:** *V. odoratissima* Bory, nom. illeg. [= *Chrysopogon zizanioides* (L.) Roberty].

Perennials, rarely annuals. Leaves mostly basal, conduplicate to flat. Ligule a ciliolate rim. Panicles terminal, espatheate, branches usually simple, solitary to whorled; racemes 1–14-jointed, fragile, joints and pedicels slender. Spikelets paired, one sessile, one pedicelled, heteromorphous. Sessile spikelets 2-flowered, the lower floret epaleate, sterile, the upper bisexual; lanceolate in outline, laterally compressed. Callus usually pungent, oblique, sometimes rounded, blunt, usually distinctly bearded. Lower glume chartaceous to coriaceous, dorsally convex, 5–7-nerved; upper glume boatshaped, keeled, 3–5-nerved, apex usually long-mucronate. Apex of upper lemma rounded to bifid, usually awned, awn (sub)apical, terminal or from a small sinus. Lodicules glabrous. Stamens 3, rarely 2. Pedicels free of the rhachis. Pedicelled spikelets dorso-ventrally compressed, from reduced to a single glume to 2-flowered, and sterile or male. x = (5?) 10.

***Distribution*:** c. 45 species in the Old World tropics, with 1 in Cuba and Florida; 11 in Thailand, 13 in Malesia of which 1 or 2 are introduced.

The SE N American species suggests that the genus may already have been in existence in the early Tertiary as part of a boreotropical flora [see Tiffney 1985].

Key to species of *Chrysopogon* in Thailand

1. Sessile spikelets callus rounded, obtuse to oblique, pungent, usually less than 2.5 mm (sometimes longer in *C. filipes*, *C. orientalis*, but then not acicular) 2
   Sessile spikelets callus more or less acicular, 3.6–6.4 mm long. – Callus setose. Column glabrous. Pedicelled spikelets lower glume glabrous. Common weed of lawns. . . . . **1. C. aciculatus**

2. Sessile spikelets callus rounded, laterally subglabrous to ciliate at base, especially near the base of the pedicel. Awn enclosed to exserted, straight, 0–5.25 mm long. Pedicelled spikelets lower glume aculeate, especially on the nerves. – Racemes 6–14-jointed. Column glabrous. Pedicel scaberulous 3
   Sessile spikelets callus oblique, obtuse to pungent, callus setose.

Awn long-exserted, usually geniculate, 13–60 mm long. Pedicelled spikelets lower glume glabrous to setulose. – Racemes 1–8-jointed. Sessile spikelets upper glume apex mucronate, mucro 0.75–17 mm long 4

3. Sessile spikelets upper glume apex mucronate, mucro 0.2-1.5 mm long. Second lemma awned, awn exserted, 2.5–5.25 mm long. – Roots without oil. Wild species ..... **4. C. festucoides**
Sessile spikelets upper glume apex muticous. Second lemma muticous or briefly awned, awn usually enclosed, 0–1.95(–4.5) mm long. – Roots with oil. Cultivated species ..... **16. C. zizanioides**

4. Sessile spikelets callus hairs white. Pedicel glabrous, smooth to apically setose. – Ligule 0.15–0.2 mm long. Leaf blades above glabrous or with a few bristles, margins and midrib underneath pectinately setulose. Panicle 9–30 by 1–3.5 cm, pale yellow to purplish. Raceme peduncles 0.6–5 cm long. Pedicel more than half as long as the sessile spikelet. Sessile spikelets lower glume apex muticous to bidentate or mucronate 5
Sessile spikelets callus hairs golden. Pedicel setose on the edges. – Awn geniculate with contorted column 6

5. Panicle lowermost longest branch 5–8 cm long. Sessile spikelets lower glume glabrous or distally pilulose. Awn geniculate with contorted column and straight arista. Pedicelled spikelets with 1 male floret ..... **8. C. lawsonii**
Panicle lowermost longest branch 2–3.5 cm long. Sessile spikelets lower glume aculeate, especially on the nerves, and setulose. Awn straight. Pedicelled spikelets with 1 sterile floret or reduced to 2 glumes ..... **10. C. nemoralis**

6. Pedicel less than half as long as the sessile spikelet. Sessile spikelets lower glume apex acute or bi-dentate. – Panicle 3–15 cm long 7
Pedicel slightly less to more than half as long as the sessile spikelet. Sessile spikelets lower glume apex obtuse. – Panicle purplish, 7.5–20 cm long. Upper glume of sessile spikelet without a dorsal tuft of hairs. ..... **11. C. orientalis**

7. Panicle purplish. Upper glume of sessile spikelet without a dorsal tuft of hairs 9
Panicle pale yellow. Upper glume of sessile spikelet with a dorsal tuft of hairs. – Ligule 0.2–0.5 mm long. Leaf blades above glabrous to puberulous, margin at base pectinate. Panicle 1.5–3 cm wide, lowermost longest branch 3–7 cm long. Raceme peduncles 2–6 cm long. Pedicel hairs 3–4.9 mm long ..... **6. C. fulvus**

8. Ligule 0.6–1.1 mm long. Leaf blades above puberulous, margin at base pectinate. Panicle 4–6 cm wide, lowermost longest branch 6–9 cm long. Raceme peduncles 5–8 cm long. Pedicel hairs 3.9–6 mm long ..... **12. C. perlaxus**
Ligule 0.2–0.4 mm long. Leaf blades above glabrous, margin at base not pectinate. Panicle 1–2 cm wide, lowermost longest branch 1–5 cm long. Raceme peduncles 1–3 cm long. Pedicel hairs 1.2–2.1 mm long ..... **13. C. serrulatus**

Key to Species of *Chrysopogon* in Malesia

1. Sessile spikelets callus rounded, or oblique and obtuse to pungent 2
   Sessile spikelets callus more or less acicular. – Culms 0.15–0.5 m tall. Panicle 4–10 by 1–3 cm, purplish. Sessile spikelets callus setose. Pedicel glabrous, smooth to scaberulous. Common weed of lawns . . . . . **1. C. aciculatus**

2. Sessile spikelets callus rounded or oblique, obtuse. – Perennials. Panicle longest branch 3–12 cm long. Pedicel glabrous 3
   Sessile spikelets callus oblique, pungent. – Sessile spikelets callus setose 5

3. Culms 1.5–2.5 m tall. Panicle 15–33 by 2.5–6 cm, purplish. Sessile spikelets callus laterally ciliate at base, especially near the base of the scaberulous pedicel 4
   Culms 0.6–1 m tall. Panicle 7–12 by 0.6–2 cm, pale yellow. Sessile spikelets callus setose. Pedicel glabrous, smooth . . . . . **3. C. celebicus**

4. Sessile spikelets upper glume apex mucronate, mucro 0.2–1.5 mm long. Second lemma awned, awn exserted, 2.5–5.25 mm long. – Roots without oil. Wild species . . . . . **4. C. festucoides**
   Sessile spikelets upper glume apex muticous. Second lemma muticous or briefly awned, awn usually enclosed, 0–1.95(–4.5) mm long. – Roots with oil. Cultivated species . . . . . **16. C. zizanioides**

5. Pedicel at least apically setose. – Perennials. Panicle 3–15 cm long, lowermost longest branch 1–6 cm long. Malay Peninsula, Sumatra, Borneo, Philippines 6
   Pedicel glabrous, smooth, or scaberulous. – Unknown from Sumatra, Borneo 9

6. Panicle lowermost branches whorled. Awn geniculate with contorted column and straight arista. Sessile spikelets anthers 2–4.3 mm long. Pedicel setose on the edges. – Malay Peninsula, Sumatra, Borneo 7
   Panicle lowermost branches solitary to paired. Awn straight. Anthers 1.4–1.7 mm long. Pedicel at most apically setose. – Panicle with many spikelets, purplish. Malay Peninsula, Philippines (Panay) . . . . . **13. C. nemoralis**

7. Panicle with many spikelets, purplish. Sessile spikelets anthers 2.25–3.75 mm long. – Malay Peninsula, Sumatra. 8
   Panicle with few spikelets, pale yellow. Sessile spikelets anthers 2–2.2 mm long. – Sessile spikelets lower glume setulose, apex acute. Borneo . . . . . **2. C. borneensis**

8. Pedicel slightly less to more than half as long as the sessile spikelet. Awn 30–57.5 mm long, column hairs 0.2–0.9 mm long. – Callus 1–3.5 mm long, hairs 1.7–2.85 mm long. Upper glume mucro 8–17 mm long . . . . . **11. C. orientalis**
   Pedicel much less than half as long as the sessile spikelet. Awn 18–30 mm long, column hairs 0.1–0.15 mm long. – Callus 0.9–1.5 mm long, hairs 1.6–1.9 mm long. Upper glume mucro 6–10 mm long . . . . . **13. C. serrulatus**

9. Perennials. Panicle lowermost longest branch 1.4–13.5 cm long 10
   Annuals. Panicle lowermost longest branch 0.7–1 cm long. – Culms 0.1–0.4 m tall. Panicle 1–4 cm long, with few spikelets.

Sessile spikelets 4.5–6 mm long (incl. callus), callus hairs golden, lower glume apex obtuse. Sessile spikelets anthers 0.85–1.2(–1.65) mm long. E. Java, Madura, Sumba, Luzon ..... **14. C. subtilis**

10. Panicle 9–30 cm long, with many spikelets. Sessile spikelets lower glume apex acute or bi-dentate, not mucronate. – Malay Peninsula or New Guinea 11
Panicle 3–8 cm long, with few spikelets. Sessile spikelets lower glume apex obtuse, or mucronate, or bi-dentate and mucronate. – Sessile spikelets anthers 1.5–2.25 mm long. Lesser Sunda Isl ..... **15. C. tenuiculmis**

11. Panicle lowermost branches whorled, lowermost longest branch 4.8–13.5 cm long. – New Guinea 12
Panicle lowermost branches paired or solitary, lowermost longest branch 2–3.5 cm long. – Culms 0.4–0.9 m tall. Sessile spikelets 5.6–8.25 mm long (incl. callus), callus hairs golden. Sessile spikelets anthers 1.4–1.7 mm long. Malay Peninsula, Philippines (Panay) ..... **10. C. nemoralis**

12. Culms 1.6–2 m tall. Sessile spikelets 5.3–7.1 mm long (incl. callus), callus hairs white. Sessile spikelets anthers 0.6–1.5 mm long 13
Culms 0.7–1.5 m tall. Sessile spikelets 8–10.6 mm long (incl. callus), callus hairs golden. Sessile spikelets anthers 2.25–3.9 mm long. – Panicle lowermost longest branch 6–13.5 cm long. Raceme peduncles 1.3–8 cm long, scaberulous. Awn straight, 10–35 mm long. Pedicel 3.75–8 mm long ..... **5. C. filipes**

13. Panicle lowermost longest branch 7c. 4.8 cm long. Raceme peduncles c. 3 cm long, smooth. Sessile spikelets 6.6–7.1 mm long (incl. callus), callus hairs 1.2–1.6 mm long. Awn straight, 15–16 mm long. Sessile spikelets anthers 1.3–1.5 mm long. Pedicel 4.1–4.5 mm long ..... **7. C. intercedens**
Panicle lowermost longest branch 6.5–7.5 cm long. Raceme peduncles 4–4.5 cm long, scaberulous. Sessile spikelets 5.3–6.3 mm long (incl. callus), callus hairs 1.8–3.6 mm long. Awn geniculate with contorted column and straight arista, 5.2–14 mm long. Sessile spikelets anthers 0.6–1 mm long. Pedicel 2.25–3.4 mm long ..... **9. C. micrantherus**

1. Chrysopogon aciculatus (Retz.) Trin., Fund. Agrost. (1820) 188;

Andropogon aciculatus Retz., Obs. 5 (1789) 22 (*'aciculatum'*); *Rhaphis trivialis* Lour., Fl. Cochinch. (1790) 553, nom. superfl.; *Andropogon acicularis* Willd., Sp. Pl. ed. 4, 4 (1806) 906, orth. var. = *Andropogon aciculatus* Willd.; *Rhaphis acicularis* (Retz.) Desv., Opusc. (1831) 69, orth. var. = *Rhaphis aciculatus* (Retz.) Desv.; *Chrysopogon trivialis* Walker-Arnott & Nees, Nov. Act. Nat. Cur. 19, Suppl. 1 (1841) 39, (1843) 171 (by inference, reference to basionym not given, no description), nom. superfl.; *Chrysopogon acicularis* Duthie, Grass. N.W. Ind. (1883) 22, orth. var. = *Chrysopogon aciculatus* (Retz.) Trin.; *Rhaphis aciculatus* (Retz.) Honda, Bot. Mag. Tokyo 40 (1926) 103; *Rhaphis zizanioides* var. *aciculata* (Retz.) Roberty, Petite Fl. Ouest-Afr. (1954) 403, nom. inval. **Lectotype:** *Koenig* in Hb. Retz. (holo: LD, K neg. 7082, photo in BRI; here proposed).

[*Kudirra-pullu* Rheede, Hort. Malab. 12 (1693) 79 ('97'), t. 43].

[*Gramen aciculatum* Rumph, Hb. Amb G. (1750) 13, t.5, f,1]

Andropogon subulatus Presl, Rel. Haenk. 1 (1830) 341; *Chrysopogon subulatus* (Presl) Trin. ex Steud., Nomencl. ed. 2, 1 (1840) 93, 360. **Type:** *Haenke* s.n. (holo: PR).

[*Rhaphis javanica* Nees in Hook., J. Bot. Kew. 2 (1850) 99, nomen for Cuming 555 from the Philippines; the specimen in TCD is labeled '*Chrysopogon javanicum*' by Nees himself.]; *Andropogon javanicus* Steud., Syn. 1 (1854) 396 ('Java'). **Lectotype:** *Junghuhn* s.n. (holo: P; iso: L?; here proposed).

Chrysopogon aciculatus var. *longifolius* Buse, Pl. Jungh. 3 (1854) 361. **Type:** *Junghuhn* s.n. (holo: L no. 908.86-159).

Perennials. Culms 0.15–0.5 m tall. Ligule 0.1–0.3 mm long. Leaf blades flat to conduplicate, 1.5–6(–23) cm by 3–7 mm, adaxially glabrous, with margins spiny. Panicle 4–10 by 1–3 cm in outline, with many branches and spikelets, purplish; lowermost branches whorled (or sometimes with one or a few separate branches below the lowermost whorl), with longest branch simple, 1.5–2.7 cm long. Raceme peduncles 1.3–2 cm long, smooth, with a terminal triad, and rarely with up to 4 spikelet groups per branch (fide Roberty, 1954, 1960, see note). Sessile spikelets 7.5–9 mm long (incl. callus), callus more or less acicular, 3.6–6.4 mm long, setose, with hairs 0.45–1.1 mm long, golden. Lower glume smooth, setulose, with apex acute to bi-dentate. Upper glume with midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, mucro (0.5–)1–1.9 mm long. Second lemma awned, the awn exserted, straight, 5.25–8 mm long, with column glabrous. Anthers 3, (0.5–)0.8–1.25 mm long. Pedicel 2.25–3.75 mm long, more than half as long as the sessile spikelet, glabrous, smooth to scaberulous upwards. Pedicelled spikelets with 1 male floret rarely reduced to only 2 glumes, 4.9–7.1 mm long. Lower glume smooth, setulose, muticous to mucronate, with mucro 0–1.05 mm long. Upper glume muticous, rarely mucronate, with mucro 0–1.1 mm long. Anthers 1.5–2.7 mm long. 2n = 20.

***Distribution, habitat and ecology*:** Tropical Asia, Polynesia, throughout Malesia (but not yet seen from Bali or Brunei), introduced elsewhere. Said to be introduced in Malesia as well, at least in the Philippines [Merrill, Sp. Blanc. (1918) 62] but already known to Rumphius from Ambon (end 17th century). Dry, sunny localities, open grasslands, lawns, beaches, along roads, in teak forest, etc.; at 0 to 1250(–2000) m altitude; resistant to trampling and fire; vegetation-forming.

***Uses*:** 'Lawns, ground cover in erosion control, may become a noxious weed because the diaspores adhere to clothing and fur and may penetrate the skin in man and cattle causing itches and sores. Eaten by horses and cattle when not in fruit but of low nutritional value.

***Vernacular name*:** Love grass (E.) (because the diaspores adhere to passing objects).

***Notes*:** In former times this species was regarded as belonging to a distinct genus (*Rhaphis*) because of its very long callus, that is obliquely attached to the top of the peduncle of the raceme. Usually this species has only a single terminal triad of spikelets on each panicle branch but Roberty (1954: 403; 1960: 290) reported the presence of up to 4 diads beneath it. I have seen a few such specimens in Johor, Kuala Lumpur, and Selangor, with a diad underneath the triad of the lowermost branch (for instance *Veldkamp* 8757, L). The anthers of the sessile spikelet are distinctly smaller than those of the pedicelled ones and occasionally appear to be staminodial, rendering the floret functionally female. The leaves of this species are usually rather short, those of the culms being reduced to small leaf blades. On young shoots long leaves may occur which led to the name *C. aciculatus* var. *longifolius* Buse for such plants.

2. Chrysopogon borneensis Henr., Blumea 4 (1941) 534. **Type:** *Endert* 5271 (holo: L; iso: BO).

Perennials. Culms 0.25–0.5 m tall. Ligule c. 0.3 mm

long. Leaf blades conduplicate, 4–10 cm by 1.2–3.5 mm, adaxially glabrous, with margins pilose at base. Panicle 3–4 by c. 1.5 cm in outline, with few branches and spikelets, pale yellow; lowermost branches whorled, with longest branch simple, c. 3 cm long. Raceme peduncles c. 2.5 cm long, smooth and puberulous at base, with a terminal triad. Sessile spikelets 6.35–6.5 mm long (incl. callus), callus oblique, pungent, 0.9–1.35 mm long, setose, with hairs 1.2–1.3 mm long, golden. Lower glume smooth, setulose, with apex acute. Upper glume with midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro 1–4.5 mm long. Second lemma awned, the awn exserted, geniculate with contorted column and straight arista, 11–20 mm long, with column puberulous, with hairs c.c 0.1 mm long. Anthers 3, 2–2.2 mm long. Pedicel 2.25–3.5 mm long, slightly less to more than half as long as the sessile spikelet, setose on the edges, with hairs 1.8–1.9 mm long. Pedicelled spikelets with 1 male floret, 4.65–5.25 mm long. Lower glume smooth, setulose, mucronate, with mucro 0.4–3 mm long. Upper glume muticous to mucronate, with mucro 0–0.4 mm long. Anthers 1.8–2 mm long.

***Distribution and habitat*:** E Borneo (Kutai). Limestone rock in low, open forest; at 100 to 200 m altitude.

***Notes*:** *Chrysopogon borneensis* is very similar to *C. tenuiculmis*, differing from that, as far as can be told from the only specimen seen, by the following characters:

-. Lowermost longest branch of the panicle c. 3 cm long. Raceme peduncles c. 2.5 cm long. Sessile spikelets with callus hairs 1.2–1.3 mm long. Pedicelled spikelets with anthers 1.8–2 mm long. Pedicel setose on the edges. ..... *Chrysopogon borneensis*

-. Lowermost longest branch of the panicle 1.4–2.5 cm long. Raceme peduncles 0.8–1.5 cm long. Sessile spikelets with callus hairs 1.9–2.55 mm long. Pedicelled spikelets with anthers 2.1–2.8 mm long. Pedicel glabrous, smooth. ..... *Chrysopogon tenuiculmis*

3. Chrysopogon celebicus Veldk., **sp. nov.**. A *Chrysopogon* is speciebus asiaticis in culmis 0.6–1 m altis, paniculis 7–12 cm longis 0.6–2 cm latis pallide flavidis, spiculae sessilis callo rotundato ad oblique obtuso 0.6–0.75 mm longo pilis albis, glumae superioris mucrone 0.45–1.85 mm longo, lemmatis secundi arista 3.75–9 mm longa, spiculis pedicellatis 1.95–4.5 mm longis differt. **Typus:** *Meijer* 9189 (holo: L; iso: A, BO, KY, MO, US).

Perennials. Culms 0.6–1 m tall. Ligule 0.15–0.5 mm long. Leaf blades conduplicate, 16.5–85 cm by 4–12 mm, adaxially glabrous to sparsely pilose. Panicle axillary and terminal, 7–12 by 0.6–2 cm in outline, with many branches and spikelets, pale yellow; lowermost branches solitary to whorled, with longest branch simple to branched at base, branch 3–5.7 cm long. Raceme peduncles 1.5–2 cm long, scaberulous, with 4–7 spikelet groups per branch, joints 2.7–7.5 mm long, glabrous to distally setulose. Sessile spikelets 4–4.85 mm long (incl. callus), callus rounded to oblique, obtuse, 0.6–0.75 mm long, setose, with hairs 1.5–3.5 mm long, white. Lower glume spinulose, distally pilulose to setulose, with apex acute to minutely bidentate, with mucro 0–0.15 mm long. Upper glume with midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro 0.45–1.85 mm long. Second lemma awned, the awn exserted, straight to geniculate with contorted column and straight arista, 3.75–9 mm long, with column glabrous to puberulous, with hairs 0–0.05 mm long. Anthers 3, 1.35–2.15 mm long. Pedicel 2.4–4.1 mm long, more than half as long as the sessile spikelet, glabrous, smooth. Pedicelled spikelets with 1 male floret or reduced to only 2 glumes, 1.95–4.5 mm long. Lower glume smooth, distally setulose, muticous. Upper glume muticous. Anthers 3.15–3.75 mm long.

***Distribution, habitat and ecology*:** Celebes (Palu and G. Tambusisi). Grassy hills on sandy soil, along stream, locally in groups; at 0 to 300 m altitude.

***Notes*:** By the 4–7 spikelet groups and the rounded to slightly oblique callus of the sessile spikelet it is most similar to the species formerly included in *Vetiveria* s.s., but it has the long callus hairs, long, geniculate awn, and puberulous column of a *Chrysopogon* s.s. species.It is similar to *C. lawsonii* and *C.*

nemoralis, but differs as follows:

-. Sessile spikelets upper glume mucro 0.45–1.85 mm long. Sessile spikelets second lemma awn 3.75–9 mm long. Pedicelled spikelets 1.95–4.5 mm long.....*Chrysopogon celebicus*

-. Sessile spikelets upper glume mucro 3.75–12.7 mm long. Sessile spikelets second lemma awn 18–29 mm long. Pedicelled spikelets 6–7.8 mm long.....*Chrysopogon lawsonii*

-. Spikelet groups 4–7 per branch. Sessile spikelets 4–4.85 mm long (incl. callus), callus rounded to oblique, obtuse, 0.6–0.75 mm long. Awn 3.75–9 mm long....*Chrysopogon celebicus*

-. Spikelet groups 1–3 per branch. Sessile spikelets 5.6–8.25 mm long (incl. callus), callus oblique, pungent, 1.2–1.7 mm long. Awn 13–22 mm long.....*Chrysopogon nemoralis*

4. Chrysopogon festucoides (Presl) Veldk., **comb. nov.**; *Andropogon festucoides* Presl, Rel. Haenk. 1 (1830) 340; *Vetiveria festucoides* (Presl) Ohwi, Bull. Tokyo Sc. Mus. 18 (1947) 4. **Type:** *Haenke* s.n. (holo: PR; iso: W no. 257377, neg. 1220; s.n., neg. 1221).

Andropogon anias Llanos, Fragm. Pl. Filip. (1851) 29. **Type:** not extant. Neotype: Merrill Sp. Blanc. (*J.K. Santos*) 389 (holo: US; iso: A, BM, BO, K, L, MO, NSW, NY, P, here designated), probably the same as BS 22238 (*J.K. Santos*) (K, L) which was collected on the same date in the same place and so seems a double-numbered gathering.

Andropogon muricatus var. *aristatus* Buse in De Vriese, Pl. Ind. Bat. Or. (1856) 104. **Type:** *Kleinhoff* s.n. in Hb. Reinwardt (holo: L no. 903.342-379).

[*Andropogon squarrosus* auct. non L.f.]

[*Andropogon squarrosus* var. *nigritanus* auct. non Hack.]

[*Andropogon zizanioides* auct. non Urban.]

[*Chrysopogon zizanioides* var. *nigritanus* auct. non Roberty.]

Vetiveria lawsonii auct. non Blatter & McCann (See note).]

[*Vetiveria nigritana* auct. non Stapf.]

Perennials. Culms 1.5–2.5 m tall. Ligule 0.45–1.3 mm long. Leaf blades conduplicate, 17–74 cm by 4–13 mm, adaxially glabrous to pilose in the lower part. Panicle 15–27 by 3.5–6 cm in outline, with many branches and spikelets, purplish; lowermost branches whorled, with longest branch simple, 6–9.5 cm long. Raceme peduncles 0.6–3.5 cm long, scaberulous, with 8–13 spikelet groups per branch, joints 4.1–9.2 mm long, glabrous to setulose. Sessile spikelets 4.1–5.4 mm long (incl. callus), callus rounded, 0.75–1.1 mm long, laterally ciliate at base, especially near the base of the pedicel, with hairs 0.4–1.5 mm long, white to golden. Lower glume spinulose, aculeate, especially on the nerves and setulose, with apex acute. Upper glume aculeate, especially on the midrib and midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro 0.2–1.5 mm long. Second lemma awned, the awn exserted, straight, 2.5–5.25 mm long, with column glabrous. Anthers 3, 1.5–2.1 mm long. Pedicel 2.25–3.15 mm long, more than half as long as the sessile spikelet, scaberulous. Pedicelled spikelets with 1 male or sterile floret, 3.75–5.25 mm long. Lower glume scaberulous, aculeate, especially on the nerves, muticous. Upper glume muticous. Anthers 1.5–2.2 mm long.

***Distribution and habitat*:** India (Assam), Upper Burma (Myitkyina), Thailand (Central: Ang Thong; Bangkok; Chaimat, Manorom), S. Laos, Vietnam (Dac Lac, ? Dongthap, see note), Malesia [Sumatra, E. Coast, Tomah Rajah, Java (Jakarta; Kangean Isl.); Philippines (Luzon: Pampanga, Nueva Ecija Provinces)]. Level land, rice fields on humid to swampy soil, Miscanthus grassland, locally dominant; at 0 to 500 m altitude.

***Uses*:** None recorded; the roots are odourless [Merrill, Sp. Blanc. (1918) 61–62; Enum. Philip. Fl. Pl. 1 (1923) 44]. Very unpalatable to stock (Hacker 1559).

***Notes*:** *Chrysopogon festucoides* is morphologically very close to *C. zizanioides*,

differing mainly from it by the mucronate upper glume of the sessile spikelet and the exserted awn. The collection from Upper Assam by Jenkins in Hb. Hooker (K) belongs to this species. *Belcher* 855 (A, US) is the only record for Upper Burma. Four collections of this species from Central Thailand have been seen in K: *Kerr* 7852, Bangkok, 19669, Chaimat, Manorom, and *Sørensen* et al. 2105, 71 km N of Bangkok. From this region, there is also *Put* 2593, Ang Thong, which has the long anthers of *C. nigritana*, but which, because of the provenance, is included here. At least part of A. Camus' *V. zizanioides* var. *genuina* from S. Laos (Thorel s.n., Lu Khou; P) also belongs here.

It might be that the plant from Vietnam (Dongthap) depicted by Ho [Cayco Vietnam 3/2 (1993) 879 as *V. lawsonii* (Hook. f.) Blatter & McCann] belongs here. I have seen a collection from Dac Lac Prov. (M'Drak, *Hacker* 1559, L; BRI, n.v.), it has glabrous nodes.

Chrysopogon nigritanus is very similar and has been confused with it. The two differ mainly in:

-. Sessile spikelets anthers 1.5–2.1 mm long, of the pedicelled spikelets 1.5–2.1 mm long. SE Asia.....*Chrysopogon festucoides*

-. Sessile spikelets anthers 2.5–2.85 mm long, of the pedicelled spikelets 2.5–3 mm long. Africa.....*Chrysopogon nigritanus*

5. Chrysopogon filipes (Benth.) Reeder, J. Arn. Arb. 29 (1948) 360; *Chrysopogon elongatus* var. *filipes* Benth., Fl. Austr. 7 (1878) 539; *Andropogon elongatus* var. *filipes* Hack., Mon. Androp. (1889) 565; *Vetiveria filipes* C.E. Hubb., Kew Bull.(1934) 444; *Rhaphis elongatus* var. *filipes* Keng, Sinensia 10 (1939) 314, nom. inval. **Lectotype:** *Mitchell* s.n. (holo: K, holo, photo in BRI; iso: MEL; here proposed).

Chrysopogon filipes var. *arundinaceus* Reeder, J. Arn. Arb. 29 (1948) 360; *Vetiveria filipes* var. *arundinacea* Jansen, Acta Bot. Neerl. 2 (1953) 386. **Type:** *Brass* 8460 (holo: A; iso: BRI, L, US).

Perennials. Culms 0.7–1.5 m tall. Ligule 0.2–0.75 mm long. Leaf blades conduplicate, 20–67 cm by 3–8 mm, adaxially glabrous to pilose in the lower part. Panicle 15–30 by 3–6 cm in outline, with many branches and spikelets, purplish; lowermost branches whorled, with longest branch simple, 6–13.5 cm long. Raceme peduncles 1.3–8 cm long, scaberulous, with (1–)3–7 spikelet groups per branch, joints 5–16(–20) mm long. Sessile spikelets 8–10.6 mm long (incl. callus), callus oblique, pungent, 2–4 mm long, setose, with hairs 0.75–2.25 mm long, golden. Lower glume spinulose, aculeate, especially on the nerves and setulose, with apex bi-dentate, with mucro 0–0.7 mm long. Upper glume aculeate, especially on the midrib and midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro 1.5–6 mm long. Second lemma awned, the awn exserted, straight, 10–35 mm long, with column puberulous, with hairs 0.1–0.15 mm long. Anthers 3, (1.9–)2.25–3.9 mm long. Pedicel 3.75–8 mm long, more than half as long as the sessile spikelet, glabrous, smooth to scaberulous. Pedicelled spikelets with 1 male floret or reduced to only 1 glume, 1.1–8.6 mm long. Lower glume smooth, setulose, muticous. Upper glume muticous. Anthers (1.9–)2.25–3.9 mm long.

***Distribution, habitat and ecology*:** Australia (N. Territory to N.S. Wales), Malesia (Papua New Guinea: Western Province). Savannah (Eucalypt) forest on alluvial flat of creek, wet gully in savanna grassland, locally common; at 0 to 30 m altitude.

***Vernacular name*:** Australian vetiver (E.).

***Uses*:** Readily eaten by stock.

***Notes*:** Reeder (and Jansen) distinguished a var. *arundinacea*. Now that more material is available, this falls within the range of variability of the Australian forms and hence is not worth recognizing formally.

Most similar to *C. filipes* are *C. oliganthus* and *C. sylvaticus*, also from Australia, which may be distinguished as follows:

-. Raceme peduncles scaberulous. Sessile spikelets 8–10.6 mm long (incl. callus), lower glume aculeate, especially on the nerves and

setulose, upper glume mucro 1.5–6 mm long, anthers 2.25–3.9 mm long. *Chrysopogon filipes*

-. Raceme peduncles smooth. Sessile spikelets 4.5–7.65 mm long (incl. callus), lower glume glabrous to distally pilulose, upper glume mucro 0–0.4 mm long, anthers 1.05–1.2 mm long. ..... *Chrysopogon oliganthus*

-. Sessile spikelets 8–10.6 mm long (incl. callus), lower glume aculeate, especially on the nerves and setulose, the awn straight. Pedicelled spikelets lower glume smooth .... *Chrysopogon filipes*

-. Sessile spikelets 6–7.5 mm long (incl. callus), lower glume glabrous to distally pilulose, the awn geniculate with contorted column and straight arista. Pedicelled spikelets lower glume scaberulous..... *Chrysopogon sylvaticus*

For the differences with *C. micrantherus*, see there.

6. Chrysopogon fulvus (Spreng.) Chiov., Fl. Somala 1 (1929) 327; *Pollinia fulva* Spreng., Pl. Min. Cog. Pug. 2 (1815) 10, comb. incorr.; *Andropogon sprengelii* Kunth, Rev. Gram. 1 (1829) 166, non *A. fulvus* Spreng. (1815). **Type:** 'Bengal' (Hb. Trinius 337.01, LE, left satchel, iso, IDC microfiche BT-16/1).

Chrysopogon montanus Trin. in Spreng., Neue Entd. 2 (1821) 93; *Andropogon monticola* Schult. & Schult.f., Mant. 3 (1827) 665, non *A. montanum* Roxb. (1820); *Chrysopogon monticola* (Schult. & Schult.f.) Haines, Ind. For. 40 (1914) 495, nom. superfl.; *Andropogon monticola* var. *genuinus* Hack., Mon. Androp. (1889) 558, nom. inval.; *Chrysopogon fulvus* subvar. *montanus* (Trin.) Roberty, Boissiera 9 (1960) 283, 287, nom. inval. **Type:** *Koenig* s.n. ex Hb. Banks in Hb. Jacquin (holo: W; iso: BM; Hb. Trinius 337.01, upper right satchel and left hand drawing, LE, iso, IDC microfiche BT-16/1).

Perennials. Culms 0.2–1.2 m tall. Ligule 0.2–0.5 mm long. Leaf blades flat, 15–30 cm by 2–3(–9) mm, adaxially glabrous to puberulous, with the margin pectinate in the lower part. Panicle 4–11(–15) by 1.5–3 cm in outline, with many branches and spikelets, pale yellow; lowermost branches whorled, with longest branch simple, 3–7 cm long. Raceme peduncles 2–6 cm long, puberulous, with a terminal triad, rarely with 2 spikelet groups per branch, joints 1–2 mm long, setose. Sessile spikelets 3.5–6.5(–8) mm long (incl. callus), callus oblique, pungent, 0.75–1.5 mm long, setose, with hairs 1.5–1.9 mm long, golden. Lower glume smooth, distally pilulose, with apex acute. Upper glume with midrib distally setulose, with a dorsal fringe of hairs, with apex mucronate, with mucro 6–20 mm long. Second lemma awned, the awn exserted, geniculate with contorted column and straight arista, 12–40 mm long, with column puberulous, with hairs 0.2–0.4 mm long. Anthers 3, 2–4.5 mm long. Pedicel 1–2.5 mm long, much less than half as long as the sessile spikelet, setose on the edges, with hairs 3–4.9 mm long. Pedicelled spikelets with 1 male floret, 2.5–8 mm long. Lower glume smooth, puberulous, muticous to mucronate, with mucro 0–7 mm long. Upper glume muticous. Anthers 3.15–4.5 mm long. 2n = 20, 80.

***Distribution, habitat and ecology*:** Sri Lanka, S India to NW (Tak) and SW Thailand (Kanchanaburi). Roadsides, grasslands, open dry deciduous forest, locally vegetation-forming; at 0 to 300 m altitude.

***Uses*:** Fodder and hay, used in soil erosion control.

***Notes*:** I do not think that *Chrysopogon montanus* is homotypic with Pollinia fulva even though material of both is present on the same sheet in the Trinius herbarium. In the original publication no reference was made to P. fulva, and the specimen was said to be in Jacquin's herbarium, not Sprengel's. I think the specimens came together after 1821 when Trinius realized they were conspecific: in Acta Acad. Imp. Sc. Petersb. VI, 2 (1832) 318 (top!) P. fulva is cited as a synonym of *C. montanus*. It should of course have been the other way around.

C. fulvus is most similar to *C. orientalis* and *C. serrulatus*. It can be distinguished from *C. orientalis* as follows:

-. Panicle pale yellow. Sessile spikelets upper glume with a dorsal tuft of hairs. Pedicel much less than half as long as the sessile spikelet. .....*Chrysopogon fulvus*

-. Panicle purplish. Sessile spikelets upper glume without a dorsal tuft of hairs. Pedicel slightly less to more than half as long as the sessile spikelet. .....*Chrysopogon orientalis*

It can be distinguished from *C. serrulatus* as follows:

-. Panicle pale yellow. Sessile spikelets upper glume with a dorsal tuft of hairs, column hairs 0.2–0.4 mm long. Pedicel hairs 3–4.9 mm long. .....*Chrysopogon fulvus*

-. Panicle purplish. Sessile spikelets upper glume without a dorsal tuft of hairs, column hairs 0.1–0.15 mm long. Pedicel hairs 1.2–2.1 mm long. .....*Chrysopogon serrulatus*

7. Chrysopogon intercedens Veldk., **sp. nov.** A *Chrysopogonis* speciebus asiaticis paniculae ramulis infimis verticillatis, ramo longissimo c. 4.8 cm longo, racemi pedunculo c. 3 cm longo laevi, spiculis sessilibus 6.6–7.1 mm longis (callus incl.), calli pilis albis, gluma inferiore aculeata ad setulosa, arista 15–16 mm longa, columna puberula pilis c. 0.2 mm longis, spiculis pedicellatis 5.4–6.4 mm longis differt. *Chrysopogone oligantho* proximus, qui in calli pilis aureis, spiculae sessilis glumae superioris mucrone fere absenti (0–0.4 mm longo) antheribus brevioribus (1.05–1.2 mm longis) differt. **Typus:** NGF 49350 (*Henty & Foreman*) (holo: L; iso: LAE, n.v.).

Perennials. Culms c. 1.8 m tall. Ligule c. 0.4 mm long. Leaf blades conduplicate, 60 cm or more by 5–6 mm, adaxially glabrous to pilose. Panicle c. 19 by 2 cm in outline, with many branches and spikelets, purplish; lowermost branches whorled, with longest branch simple, c. 4.8 cm long. Raceme peduncles c. 3 cm long, smooth, with 2 or 3 spikelet groups per branch, joints 5.6–12 mm long, setulose. Sessile spikelets 6.6–7.1 mm long (incl. callus), callus oblique, pungent, 1.5–1.7 mm long, setose, with hairs 1.2–1.6 mm long, white. Lower glume spinulose, aculeate, especially on the nerves and setulose, with apex acute to minutely bidentate. Upper glume with midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro 1.6–3 mm long. Second lemma awned, the awn exserted, straight, 15–16 mm long, with column puberulous, with hairs c. 0.2 mm long. Anthers 3, 1.3–1.5 mm long (immature?). Pedicel 4.1–4.5 mm long, more than half as long as the sessile spikelet, glabrous, smooth to slightly scaberulous. Pedicelled spikelets with 1 male to sterile floret, 5.4–6.4 mm long. Lower glume smooth, setulose, muticous. Upper glume muticous. Anthers c. 2.85 mm long.

***Distribution and habitat*:** Papua New Guinea (Western Province). Savanna woodland; at c. 15 m altitude.

***Notes*:** This species seems morphologically intermediate between *C. oliganthus* and *C. filipes*. It appears to be sympatric with the latter and might be a hybrid, were it not that the first is not yet known from New Guinea. This might explain the possibly staminodial nature of the anthers of the sessile spikelet, which coupled to a reduced fertility of the sessile spikelets, where anthers appear to be absent in some of these, would make fertilization difficult.

Chrysopogon intercedens is most similar to *C. oliganthus*, but can be distinguished as follows:

-. Sessile spikelets callus hairs white, upper glume mucro 1.6–3 mm long, anthers 1.3–1.5 mm long.....*Chrysopogon intercedens*

-. Sessile spikelets callus hairs yellow, upper glume mucro 0–0.4 mm long, anthers 1.05–1.2 mm long.....*Chrysopogon oliganthus*

8. Chrysopogon lawsonii (Hook.f.) Veldk., **comb. nov.**; [*Chrysopogon lawsonii* (Hook.f.) Roberty, Boissiera 9 (1960) 290 (cited as 'nomen superfluum', hence invalid).] *Andropogon lawsonii* Hook.f., Fl. Br. Ind. 7 (1896) 187 ('lawsoni'). *Vetiveria lawsonii* (Hook.f.) Blatter & McCann, J. Bomb. Nat. Hist. Soc. 32 (1928) 409. **Type:** *Lawson* 28 (holo: K).

Perennials. Culms 0.45–1.7 m tall. Ligule 0.15–0.3 mm long. Leaf blades flat to conduplicate,

5–23(–45) cm by 3–5 mm, adaxially glabrous, or with a few bristles, abaxially with midrib and margins pectinately setulose. Panicle 10–30 by 1–3 cm in outline, with many branches and spikelets, pale yellow to pale reddish; lowermost branches whorled to solitary, with longest branch simple to branched, 5–8 cm long. Raceme peduncles 1.5–5 cm long, smooth to slightly scaberulous, with 2–8 spikelet groups per branch, joints 1.75–7.5 mm long, glabrous. Sessile spikelets 4–6.2 mm long (incl. callus), callus oblique, obtuse, (0.5–)1.05–1.5 mm long, setose, with hairs 0.8–1.5 mm long, white. Lower glume spinulose, glabrous and distally pilulose, with apex acute to minutely bi-dentate. Upper glume with midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro 3.75–12.7 mm long. Second lemma awned, the awn exserted, geniculate with contorted column and straight arista, (14–)18–29 mm long, with column puberulous, with hairs 0.1 mm long. Anthers 3, 2–3.25 mm long. Pedicel (3–)3.7–4.1 mm long, more than half as long as the sessile spikelet, glabrous, smooth. Pedicelled spikelets with 1 male floret, 6–7.8 mm long. Lower glume smooth, setulose, usually mucronate sometimes muticous, with mucro (0–)2–6 mm long. Upper glume muticous to mucronate, mucro 0–1.5 mm long. Anthers 2–3.7 mm long. 2n = 20 (36?).

***Distribution, habitat and ecology*:** S India (S Maharashtra, S Karnataka, NW Andhra Pradesh, Tamil Nadu: Nilgiris), Thailand (N: Chiangmai, Doi Inthanon). Note the disjunction. Moist soil, banks of waterways, sandy localities, locally abundant; at 550 to 1200 m altitude.

***Uses*:** Cattle are said to eat the leaves, but avoiding the flowering culms.

***Notes*:** This species is morphologically intermediate between *Chrysopogon* and *Vetiveria* in that its sessile spikelet has the oblique hairy callus and puberulous columns as in the former, and the racemes with 2–8 groups of spikelets as in the latter. The single Thai collection seen by me (Phengklai & Smitinand 6085, K) is indistinguishable from the Indian material I have seen, except for its shorter awns (14–17 vs. 18–29 mm long) and pedicels (3–3.75 vs. 3.7–4.1 mm long). Ho [Cayco Vietnam 3/2 (1993) 879] recorded and depicted a species under this name for Vietnam. However, the plate appears to be of C. festucoides Presl, except that the nodes and leaf throat are depicted as pilose, something I have not observed in any species of *Chrysopogon* so far.

9. Chrysopogon micrantherus Veldk., **sp. nov.**
A *Chrysopogonis* omnibus speciebus asiaticis culmis 1.65–2 m vel ultra altis, foliis 50–100 cm longis, paniculis 19–27 cm longis purpurascentibus, racemi pedunculo 4–4.5 cm longo scaberulo, spiculis sessilibus 5.3–6.3 mm longis, callo obliquo pungenti incluso, pilis 1.8–3.6 mm longis albis, gluma inferiore setulosa, glumae superioris mucrone 0.4–3.45 mm longo, lemmatis secundi arista geniculata columna contorta puberula, subula stricta, antheris 0.6–1 mm longis, pedicello 2.25–3.4 mm longo, spiculis pedicellatis setulosis differt. **Typus:** *Brass* 8579 (L, holo; A, BRI, US).

[*Chrysopogon elongatus* auct. non Benth.]

[*Rhaphis elongatus* auct. non Chase.]

[*Vetiveria elongata* auct. non C.E. Hubb.]

[*Vetiveria filipes* auct. non C.E. Hubb.]

Perennials. Culms 1.65–2 m tall or more. Ligule 0.2–0.45 mm long. Leaf blades conduplicate, 50–100 cm by 3.5–11 mm, adaxially glabrous to pilose. Panicle 19–27 by 2–4.5 cm in outline, with many branches and spikelets, purplish; lowermost branches whorled, with longest branch simple, sometimes branched, 6.5–7.5 cm long. Raceme peduncles 4–4.5 cm long, scaberulous, with (1 or) 2 or 3 spikelet groups per branch, joints 4.9–8 mm long, glabrous. Sessile spikelets 5.3–6.3 mm long (incl. callus), callus oblique, pungent, 1.2–2.25 mm long, setose, with hairs 1.8–3.6 mm long, white. Lower glume spinulose to smooth, setulose, with apex acute to minutely bi-dentate, with mucro 0–0.25 mm long. Upper glume with midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro 0.4–1.8(–3.45) mm long. Second lemma awned, the awn exserted,

geniculate with contorted column and straight arista, 5.25–14 mm long, with column puberulous, with hairs c. 0.1 mm long. Anthers 3, 0.6–1 mm long. Pedicel 2.25–3.4 mm long, more than half as long as the sessile spikelet, glabrous, smooth. Pedicelled spikelets with 1 male or sterile floret, 5.7–7.85 mm long. Lower glume smooth, setulose, muticous. Upper glume muticous. Anthers 2.8–4.05 mm long (if present).

***Distribution, habitat and ecology*:** Papua New Guinea (Western Province). Heavy wet soil behind mangrove, along swamp margins; at low altitude. Locally vegetation-forming.

***Notes*:** The epithet refers to the small anthers of the sessile spikelets.

Chrysopogon filipes seems most similar to *C. micrantherus* but can be distinguished as follows:

-. Culms 0.7–1.5 m tall. Sessile spikelets 8–10.6 mm long (incl. callus), callus hairs golden, the awn straight, anthers 2.25–3.9 mm long. Pedicel 3.75–8 mm long.....*Chrysopogon filipes*

-. Culms 1.65–2, or more m tall. Sessile spikelets 5.3–6.3 mm long (incl. callus), callus hairs white, the awn geniculate with contorted column and straight arista, anthers 0.6–1 mm long. Pedicel 2.25–3.4 mm long....*Chrysopogon micrantherus*

10. Chrysopogon nemoralis (Balansa) Holtt., Gard. Bull. Singapore 11 (1947) 297; *Andropogon nemoralis* Balansa in Morot, J. Bot. 4 (1890) 113; *Vetiveria nemoralis* (Balansa) A. Camus, Fl. Gen. I.-C. 7 (1922) 329. **Type:** *Balansa* s.n. (holo: L no. 908.83-373; iso: P).

Andropogon gryllus var. *philippinensis* Merr., Philip. J. Sc., Bot. 14 (1919) 368. *Chrysopogon philippinensis* (Merr.) Henr., Blumea 4 (1941) 532; **Type:** BS 30964 (*Ramos & Edano*) (holo: PNH, lost; iso: BO, K, L).

NB. BS 30964 (Ramos & Edano) is the correct citation as used in Flora Malesiana literature, an alternative sometimes found is Ramos & Edano BS 30964. Ramos & Edano [BS 30964] is certainly wrong. I've had a long discussion about this with Ben Stone when he was devising the format for the Flora of the Philippines Inventory Report.

[*Chrysopogon gryllus* auct. non Trin.]

[*Vetiveria lawsonii* auct. non Blatter & McCann]

Perennials. Culms 0.4–0.9 m tall. Ligule 0.2–0.4 mm long. Leaf blades flat to conduplicate, 6–30 cm by 2.25–8 mm, adaxially glabrous. Panicle 9–15 by 1–2.5 cm in outline, with many branches and spikelets, pale yellow to purplish; lowermost branches solitary to paired, upwards a few together in whorls, with longest branch simple to branched at base, 2–3.5 cm long. Raceme peduncles 0.6–1.5 cm long, smooth to scaberulous, with 1–3 spikelet groups per branch, joints 4.5–10 mm long, glabrous to distally setulose. Sessile spikelets 5.6–8.25 mm long (incl. callus), callus oblique, pungent, 1.2–1.7 mm long, setose, with hairs 1.1–1.75 mm long, golden. Lower glume spinulose to smooth, setulose to aculeate, especially on the nerves, with apex acute to bidentate and mucronate, with mucro 0–0.8 mm long. Upper glume with midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro 0.75–5.25 mm long. Second lemma awned, the awn exserted, straight, 13–22 mm long, with column puberulous, with hairs 0.05–0.1 mm long. Anthers 3, 1.4–1.7 mm long. Pedicel 2.25–6.4 mm long, more than half as long as the sessile spikelet, glabrous, smooth to apically setose, hairs 0–0.7 mm long. 1-pedicelled spikelet with 1 sterile floret, or reduced to only 2 glumes, 3.2–6 mm long. Lower glume smooth, distally setulose, muticous to mucronate, with mucro 0.7–0.9 mm long. Upper glume muticous.

***Distribution, habitat and ecology*:** ? Thailand (see note) to Indo-China, Malesia (Malay Pen: Pahang, Sungei Tahan; Trengganu, Kemaman; Philippines: Panay). Note the disjunctions. Among river boulders; at up to c. 180 m altitude. Apparently very rare and local everywhere.

***Notes*:** Chinapan et al. and several other authors [Abstr. Int. Conf. to commemorate the 50th anniversary...of...the King of Thailand (1996) e.g. pp. 24, 27, 32, 43, 142] suggest that

C. nemoralis might be useful for hedges against erosion, similar to the use of *C. zizanioides*. These authors state that the species would be wide-spread in Thailand. It is therefore curious to note that there are no Thai collections of *C. nemoralis* in A, AAU, BKF, BM, BO, C, L, MO, NY, P, SING, SINU and US while it is not mentioned in the lists of Thai grasses by Bor (1962, 1965). The Thai vernacular names ('fek deng', 'fek kao', 'ya fak') refer to tall, robust, clumped grasses, so that several species perhaps not even belonging to *Chrysopogon* are possibly grown under this scientific name. The only specimen seen identified as *C. nemoralis*, said to be of the Ratchaburi race, was of *C. zizanioides*.

Chrysopogon nemoralis is apparently very rare and local; I have only seen 6 collections: the type of its name and *Eberhardt* 2216 [P, K (neg. 5002)], both from Vietnam, 3 collections from the Malay Peninsula, and the type of *C. philippinensis* from Panay. The Pahang material seen in SING (*Ridley* 2137, SF 20825) differs slightly from the Vietnamese, with the Kemaman collection [SF 25846 (*Corner*); also in SING] being somewhat morphologically intermediate.

	Vietnam	Malay Pen. (Pahang)
joints (mm)	7.5–10	4.3–6.75
callus (mm)	1.2–1.5	1.9–2.25
mucro of the upper glume of the sessile spikelet (mm)	0.75–1.65	2.6–5.25
pedicelled spikelet with	1 sterile fl.	2 glumes only

The Philippines material is also slightly different:

	Vietnam	Philippines
sessile spikelets	5.6–7.5	7.5–8.25 mm long
callus	1.2–1.5	1.6–1.7 mm long
pedicel hairs	absent	present, 0.2–0.7 mm long

11. Chrysopogon orientalis (Desv.) A. Camus, Fl. Gen. I.-C. 5 (1925) 332; [*Andropogon gryllus* auct. non L.: Rottler, Neue Schr. Ges. Naturf. Fr. Berlin 4 (1803) 207; Willd., Sp. Pl. ed. 4, 4, 2 (1806) 69, pro specim. Ind. Or.]; *Rhaphis orientalis* Desv., Opusc. (1831) 69.; *Chrysopogon verticillatus* var. *orientalis* (Desv.) Roberty, Boissiera 9 (1960) 283, 285. nom.inval. **Type:** *Klein* 392 in Hb. Willdenow 18636 (sheet 4) (holo: B, IDC microfiche 7440).

Andropogon breviaristatus Steud., Syn. 1 (1854) 396 (*'breviaristaus'*), 436; *Andropogon aristulatus* Hochst. ex Hack., Mon. Androp. (1889) 556, nomen superfl. **Type:** *Hohenacker* 1285 (holo: P; iso: L).

Andropogon wightianus Nees ex Steud., Syn. 1 (1854) 395; *Chrysopogon wightianus* (Nees ex Steud.) [Nees ex Wight, Cat. (1834) 98, nomen] Thw., Enum. Pl. Zeyl. (1864) 366. **Lectotype:** Hb. Wight 1676 ('1675' in Roberty; holo: P; iso: K, LE (Hb. Trin. 339.1 as Wight 355 ex Hb. Kunth, IDC microfiche BT-16/1; here proposed).

Chrysopogon sinensis Rendle, J. Lin. Soc. Bot. 36 (1904) 368 - **Lectotype:** *Sampson* in Hb. Hance 3453 (holo: BM; iso: US), here designated.

Chrysopogon collinus Ridl., J. Str. Br. Roy. As. Soc. 82 (1920) 203. **Type:** SF 649 (*Haniff*) (holo: SING; iso: K).

Perennials. Culms 0.65–1.1 m tall. Ligule 0.2–0.75 mm long. Leaf blades flat to conduplicate, 3–33 cm by 2–6 mm, adaxially glabrous to puberulous. Panicle 7.5–20 by 1–3 cm in outline, with many branches and spikelets, purplish; lowermost branches solitary to whorled, with longest branch simple, 3.5–6 cm long. Raceme peduncles 2.3–4.5 cm long, smooth to puberulous, with a terminal triad. Sessile spikelets 6.15–10.3 mm long (incl. callus), callus oblique, pungent, 1–4.3 mm long, setose, with hairs 1.7–2.85 mm long, golden. Lower glume smooth, glabrous or distally pilulose, with apex obtuse, rarely bi-dentate and bi-

mucronate, with mucro 0–9 mm long. Upper glume with midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro 8–17 mm long. Second lemma awned, the awn exserted, geniculate with contorted column and straight arista, 30–60 mm long, with column puberulous, with hairs 0.2–0.9 mm long. Anthers 3, 2.6–3.75 mm long. Pedicel 2.25–4(–5) mm long, slightly less than half as to more than half as long as the sessile spikelet, setose on the edges, with hairs 1–4.3 mm long. Pedicelled spikelets with 1 male floret to reduced to only 2 glumes, 5.6–8.5 mm long. Lower glume smooth, glabrous to puberulous, rarely muticous to mucronate, with mucro (0–)5.6–15 mm long. Upper glume muticous to mucronate, with mucro 0–6.75 mm long. Anthers 3.15–3.75(–4.1) mm long. 2n = 20.

***Distribution, habitat and ecology*:** Sri Lanka, S India (Tamil Nadu), Burma to S China (Hainan, Fujian), Thailand (NE: Sakon Nakhon; Central: (Bangkok); E: Nakhon Ratchasima; SW: Kanchanaburi, Phetchaburi, Ratchaburi, Prachuap Khiri Khan; Peninsular: Nakhon Si Thammarat, Narathiwat, Phuket, Satun, Songkhla, Trang; SE: Chon Buri); Malesia (Malay Pen.: Kelantan, Langkawi, Pahang, Trengganu; Sumatra: Padang). Meadows and roads on limestone and coastal sandy areas, open deciduous forest, trampling and fire resistant; at low altitude.

***Uses*:** Grazed by cattle; recommended for very poor soil.

***Notes*:** Gilliland [Rev. Fl. Mal. 3 (1971) 237] has included *C. collinus* in *C. fulvus* (Spreng.) Chiov., but the isotype of that name in K (from Setul, now S Thailand) clearly belongs here. For the differences between *C. orientalis* and *C. fulvus* see under *C. fulvus*. Occasionally the lower glume of the sessile spikelet has a bi-aristate apex, for instance in *Kerr* 10721 (BK, fide C. Hambananda msc) and *Niyomdham & Ueachirakan* 1926 (L) from Thailand. These are also occasionally present in *C. tenuiculmis*.

12. Chrysopogon perlaxus Bor, Dansk Bot. Ark. 23 (1965) 157. **Type:** *Larsen* 8015 (holo: K; iso: C).

Perennials. Culms more than 1.15 m tall. Ligule 0.6–1.1 mm long. Leaf blades flat, 13.5–25 cm by 4–8 mm, adaxially puberulous, with margins pectinate in lower part. Panicle 11–15 by 4–6 cm in outline, with many branches and spikelets, purplish; lowermost branches whorled, with longest branch simple, 6–9 cm long. Raceme peduncles 5–8 cm long, smooth to scaberulous, with a terminal triad. Sessile spikelets 7–8.25 mm long (incl. callus), callus oblique, pungent, c. 1.5 mm long, setose, with hairs 1.5–2.25 mm long, golden. Lower glume smooth, glabrous, with apex acute or minutely bi-dentate. Upper glume with midrib distally setulose, with a dorsal fringe of hairs, with apex mucronate, with mucro 6.5–10.5 mm long. Second lemma awned, the awn exserted, geniculate with contorted column and straight arista, 30–33 mm long, with column puberulous, 0.2–0.35 mm long. (Anthers n.v.). Pedicel 2.6–3 mm long, less than half as long as the sessile spikelet, setose on the edges, with hairs 3.9–6 mm long. Pedicelled spikelets with 1 sterile to 1 male floret, 7.1–7.95 mm long. Lower glume smooth, glabrous to distally setulose, muticous to mucronate, with mucro 0–8 mm long. Upper glume muticous. Anthers c. 4.1 mm long.

***Distribution and ecology*:** SE Thailand (Prachinburi: Cholburi). Dry hill; at c. 75 m altitude.

***Notes*:** *Chrysopogon* perlaxus is very similar to *C. fulvus* (Spreng.) Chiov., especially because of the peculiar tuft of hairs on the back of the upper glume of the sessile spikelet. They may be distinguished as follows:

-. Ligule 0.2–0.5 mm long. Panicle 1.5–3 cm wide, pale yellow, raceme peduncles puberulous. Sessile spikelets lower glume distally pilulose. Pedicel 1–2.5 mm long.....*Chrysopogon fulvus*

-. Ligule 0.6–1.1 mm long. Panicle 4–6 cm wide, purplish, raceme peduncles smooth to scaberulous. Sessile spikelets lower glume glabrous. Pedicel 2.6–3 mm long. .....*Chrysopogon perlaxus*

13. Chrysopogon serrulatus Trin., Mem. Acad. Sc. St. Petersb. VI, 2 (1832) 318; Icon. Gram. 3 (1835) t. 331; *Andropogon trinii*

Steud., Syn. 1 (1854) 395, non *A. serrulatum* Link (1827); *Chrysopogon trinii* (Steud.) Watson in Atkins, Gaz. N.W. Prov. India 10 (1882) 392, nom. superfl. (NB Watson cited also *C. serrulatus* and therefore should have used that combination); *Andropogon trinii* var. *genuinus* Hack., Mon. Androp. (1889) 558, nom. inval.; *Andropogon monticola* var. *trinii* (Steud.) Hook.f., Fl. Br. Ind. 7 (1896) 193; *Chrysopogon montanus* var. *serrulatus* (Trin.) Stapf, Fl. Trop. Afr. 9 (1917) 160, nom. superfl.; *Chrysopogon fulvus* subvar. *serrulatus* (Trin.) Roberty, Boissiera 9 (1960) 284, 287. nom.inval. **Type:** *Wallich* (= 8791: 'Nepal, Ao 1821') in Hb. Trinius 338.01 (holo: LE, IDC microfiche BT-16/1, K neg. 14023; iso: K, IDC microfiche 7394).

[*Chrysopogon fulvus* auct. non Chiov.]

Perennials. Culms 0.3–1 m tall. Ligule 0.2–0.4 mm long. Leaf blades flat to conduplicate, 17–30 cm by 2.25–5 mm, adaxially glabrous, throat pilose. Panicle 3–12 by 1–2 cm in outline, with many branches and spikelets, purplish; lowermost branches whorled, with longest branch simple to branched, 1–5 cm long. Raceme peduncles 1–3 cm long, smooth to puberulous, with a terminal triad. Sessile spikelets 5–8.5 mm long (incl. callus), callus oblique, pungent, 0.9–1.5 mm long, setose, with hairs 1.6–1.9 mm long, golden. Lower glume smooth, glabrous to distally pilulose, with apex acute. Upper glume with midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro 6–10 mm long. Second lemma awned, the awn exserted, geniculate with contorted column and straight arista, 18–30(–35) mm long, with column puberulous, with hairs 0.1–0.15 mm long. Anthers 3, 2.25–2.85 mm long. Pedicel 1.9–2.6 mm long, less than half as long as the sessile spikelet, setose on the edges, with hairs 1.25–2.1 mm long. Pedicelled spikelets with 1 male floret, (3–)5–8 mm long. Lower glume scaberulous to smooth, glabrous to setulose, mucronate, with mucro (1.5–)3.5–10 mm long. Upper glume muticous to mucronate, with mucro 0–6 mm long. Anthers 2.25–3.5 mm long. 2n = 20, 40, 80.

***Distribution, habitat and ecology*:** Rather disjunct: S Africa, Madagascar, Afghanistan and N India to Burma, Sri Lanka, S Thailand [Satun ('Setul'); Trang], Malesia (Malay Pen.: Pahang, Tokong Burong Isl., between P. Tioman and the mainland; S Sumatra, near Lahat). Cultivated in Manila at least between 1951 and 1955. Open, rocky slopes, or in guano of birds nesting among its tussocks (about the only vegetation on T. Burong Isl.); at 0 to 600 m altitude.

***Uses*:** Considered to be good fodder before flowering (when the awned spikelets, that may be harmful to snout and eyes are still absent); soil binder.

***Vernacular name*:** Golden beard grass (E.).

***Notes*:** *Chrysopogon* serrulatus is very similar to *C. orientalis* and is perhaps only a form of that species; see the general key and under *C. fulvus* for differences. The latter species differs mainly by the curious tuft of fulvous hairs on the back of the upper glume of the sessile spikelet. This taxon is only found in the area between Sri Lanka and Thailand. The Malesian material of *C. serrulatus* has large spikelets and lacks the tuft of hairs on the back of the upper glume of the sessile spikelet, and therefore, if the two taxa are to be kept separate, seems better placed in *C. serrulatus*.

14. Chrysopogon subtilis (Steud.) Miq., Fl. Ind. Bat. 3 (1857) 492; *Andropogon subtilis* Steud. [in Zoll., Syst. Verz. (1854) 59, nom. nud.] Syn. 1 (1854) 396. **Type:** *Zollinger* 2815 (holo: P).

Annuals. Culms 0.1–0.4 m tall. Ligule 0.15–0.4 mm long. Leaf blades flat to conduplicate, 1.2–7 cm by 0.7–2.6 mm, adaxially glabrous to sparsely pilose, with margins pectinate. Panicle 1–4 by c. 1cm in outline, with few branches and spikelets, pale yellow; lowermost branches solitary to paired, with longest branch simple, 0.7–1 cm long. Raceme peduncles 0.4–0.6 cm long, smooth to scaberulous, with a terminal triad. Sessile spikelets 4.5–6 mm long (incl. callus), callus oblique, pungent, 1.5–2.25 mm long, setose, with hairs 1.1–1.95 mm long, golden (bleaching to whitish). Lower glume smooth, distally tuberculate and setulose (not

tuberculate in Sumba), with apex obtuse. Upper glume with midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro (5.6–)6.75–11.25 mm long. Second lemma awned, the awn exserted (terminal, no lobes of lemma at base!), geniculate with contorted column and straight arista, 24–36 mm long, with column puberulous, with hairs 0.05–0.15 mm long. Anthers 2 or 3, 0.85–1.2 mm long (up to 1.65 mm in Sumba). Pedicel 1.85–3.5 mm long, more than half as long as the sessile spikelet, glabrous, smooth. Pedicelled spikelets in Sumba with 1 male floret, elsewhere reduced to only 2 glumes, (2.6–)3–4.5 mm long (up to 6 mm in Sumba). Lower glume smooth, distally puberulous, muticous to mucronate, with mucro 0–1.65 mm long. Upper glume muticous. Anthers c. 2.25 mm long (in Sumba).

***Distribution, habitat and ecology*:** Malesia (E Java: Besuki, Pasuruan; Madura; Lesser Sunda Isl.: Sumba; Philippines: Luzon, Batangas Province, Nasugbu Bay). A distribution reminiscent of that of *Sclerachne punctata* R. Br., which is found in Java, Madura, and Luzon, and of *Diectomis fastigiata* (SW.) Beauv in Malesia: E Java and the Philippines (Busuanga Isl., Hermana Mayor Isl., Luzon, and Palawan). Very dry areas with a pronounced dry season, stony, barren places, roads, sea shores, open teak forest, savannas, locally abundant; up to 300 m altitude.

***Notes*:** This species and *C. tenuiculmis* are morphologically quite similar and quite distinct from other SE Asian and Australian species, with the present species most advanced. Both have a peculiar sessile spikelet with an abruptly contracted apex of the gibbose lower glume, which in some cases may become 2-awned (as in the type of *C. tenuiculmis*). Such awns have also been seen in *C. orientalis*, q.v. The Sumba specimens examined have well-developed, male pedicelled spikelets with large anthers. In this, the taxon is even more similar to *C. tenuiculmis*.

-. Annuals. Lowermost longest branch of the panicle 0.7–1 cm long. Raceme peduncles 0.4–0.6 cm long. Callus hairs 1.1–1.95 mm long. Awn 24–36 mm long. Sessile spikelets anthers 0.85–1.2 mm long.....*Chrysopogon subtilis*

-. Perennials. Lowermost longest branch of the panicle 1.4–2.5 cm long. Raceme peduncles 0.8–1.5 cm long. Callus hairs 1.9–2.55 mm long. Awn 14–25 mm long. Sessile spikelets anthers 1.5–2.25 mm long.....*Chrysopogon tenuiculmis*

15. Chrysopogon tenuiculmis Henr., Blumea 4 (1941) 532. **Type:** *Iboet* 151 (holo: L; iso: BO, K).

[*Chrysopogon gryllus* auct. non Trin.]

Perennials. Culms 0.3–0.6(–1) m tall. Ligule 0.2–0.6 mm long. Leaf blades flat to conduplicate, 5–13(–22) cm by (1.2–)2–3(–9) mm, adaxially glabrous to pilose. Panicle (3–)5–8 by 1–2.5(–3.5) cm in outline, with few branches and spikelets, pale yellow to purplish; lowermost branches solitary to whorled, with longest branch simple, 1.4–2.5 cm long. Raceme peduncles 0.8–1.5 cm long, scaberulous, with a terminal triad. Sessile spikelets (4.1–)5.25–6(–6.5) mm long (incl. callus), callus oblique, pungent, (0.75–)1.5–2 mm long, setose, with hairs 1.9–2.55 mm long, golden. Lower glume spinulose to smooth, distally tuberculate and setulose, with apex obtuse, or mucronate, or bi-dentate and mucronate, with mucro 0–3 mm long. Upper glume with midrib distally setulose, without a dorsal fringe of hairs, with apex mucronate, with mucro (2.6–)4–8.6 mm long. Second lemma awned, the awn exserted, geniculate with contorted column and straight arista, 14–25(–28) mm long, with column puberulous, with hairs 0.15 mm long. Anthers 3, 1.5–2.25 mm long. Pedicel (2.1–)2.6–4 mm long, more than half as long as the sessile spikelet, glabrous, smooth. Pedicelled spikelets with 1 male floret, (4.5–)5.25–7(–8.25) mm long. Lower glume scaberulous to smooth, setulose to distally puberulous, muticous to mucronate, with mucro 0–4.5 mm long. Upper glume muticous to mucronate, with mucro 0–0.45 mm long. Anthers 2.1–2.8 mm long. 2n = ?

***Distribution, habitat and ecology*:** Lesser Sunda Isl. (Sumba, Flores, Lombok, Roti, Timor?, Wetar). Dry, barren soil, Eucalypt forest behind shore, locally dominant in pastures up to 1400 m altitude.

***Notes*:** Henrard (1941) erroneously reported that the upper glume of the sessile spikelet of this species would be muticous. De Castro

[Garcia de Orta 12 (1964) 52] mentioned *C. gryllus* for Timor (*Gomes da Silva* s.n., COI, n.v.), but this probably refers to *C. tenuiculmis*. See under *C. subtilis* for the close similarity with *C. tenuiculmis*. *Chrysopogon serrulatus* is morphologically somewhat similar, but may be distinguished as follows:

-. Panicle with many branches and spikelets. Sessile spikelets lower glume glabrous to distally pilulose. Pedicel less than half as long as the sessile spikelet, setose on the edges. .....*Chrysopogon serrulatus*

-. Panicle with few branches and spikelets. Sessile spikelets lower glume distally tuberculate to setulose. Pedicel more than half as long as the sessile spikelet, glabrous, smooth . .....*Chrysopogon tenuiculmis*

16. Chrysopogon zizanioides (L.) Roberty, Bull. Inst. Franç. Afr. Noire 22 (January 1960) 106; Boissiera 9 (July 1960) 291, isonym; *Phalaris zizanioides* L., Mant. 2 (1771) 183; *Sorghum zizanioides* (L.) Kuntze, Rev. Gen. Pl. 2 (1891) 791; *Andropogon zizanioides* (L.) Urban, Symb. Antill. 4 (1903) 79; *Vetiveria zizanioides* (L.) Nash in Small, Fl. SE U.S. (1903) 67; *Holcus zizanioides* (L.) Kuntze ex Stuckert, Ann. Mus. Nac. Buenos Aires 11 (1904) 48; *Anatherum zizanioides* (L.) Hitchc. & Chase, Contr. U.S. Nat. Hb. 18 (1917) 285; *Vetiveria zizanioides* var. *genuina* A. Camus, Bull. Mus. Nat. Hist. Nat. Paris 25 (1919) 673, nom.inval.; *Rhaphis zizanioides* (L.) Roberty, Petite Fl. Ouest-Afr. (1954) 403, nom.inval. **Type:** *Koenig* in Hb. Linn. 78.12 (holo: LINN, IDC microfiche).

Andropogon muricatus Retz., Obs. Bot. 3 (1783) 43; *Anatherum muricatum* (Retz.) Beauv. Agrost. (1812) 128 (*'mucronatum'*), 150, t. 22, f. 10; *Vetiveria muricata* (Retz.) Griseb., Fl. Br. W. Ind. (1864) 560; *Chamaeraphis muricata* (Retz.) Merr., Enum. Phil. Fl. Pl. 1 (1923) 75 pro comb. corrected in 1925 p. 459 to *C. squarrosa* (L.f.) Merr.,. **Type:** *Koenig* in Hb. Retz. (holo: LD, fragm. in K).

Andropogon nardus Blanco, Fl. Filip. (1837) 39. **Type:** not extant; Neotype: *Merrill* Sp. Blanc. 355 (holo: US; iso: A, BM, BO, K, L, MO, NSW, NY, P) here designated.

Vetiveria zizanioides var. *tonkinensis* A. Camus, Bull. Mus. Nat. Hist. Nat. 25 (1919) 674. **Lectotype:** *Anon.* 73 'Prairie de Yen Phu, Hanoi, 2 Aout 1907' (holo: P; here proposed).

[*Andropogon squarrosus* auct. non L.f.] (See note).

[Andropogon *squarrosus* var. *genuinus* auct. non Hack.]

[*Vetiveria nemoralis* auct. non A. Camus]

[*Vetiveria odorata* auct. non Virey.]

[*Vetiveria odoratissima* auct. non Bory.]

Perennials. Culms 1.5–2.5 m tall. Ligule 0.3–0.75 mm long. Leaf blades conduplicate, 23–94 cm by 2.5–7 mm wide, adaxially pilose in the lower part. Panicle 20–33 by 2.5–6 cm in outline, with many branches and spikelets, purplish; lowermost branches whorled, with longest branch simple, 5.5–12 cm long. Raceme peduncles 1–4 cm long, smooth to scaberulous, with 6–14 spikelet groups per branch, joints 3.75–6.75 mm long, glabrous to setulose. Sessile spikelets 3.75–6 mm long (incl. callus), callus rounded, 0.6–0.8 mm long, laterally ciliate at base, especially near the base of the pedicel, with hairs 0.1–1.35 mm long, white. Lower glume spinulose, aculeate, especially on the nerves and setulose, with apex acute. Upper glume aculeate, especially on the midrib and midrib distally setulose, without a dorsal fringe of hairs, with apex muticous. Second lemma muticous to mucronate, the awn usually enclosed, straight, 0–1.95(–4.5) mm long, with column glabrous. Anthers 3, 1.65–2.25 mm long. Pedicel 2.25–4.3 mm long, more than half as long as the sessile spikelet, scaberulous. Pedicelled spikelets with 1 male floret, 2.85–4.6 mm long. Lower glume scaberulous, aculeate, especially on the nerves, muticous. Upper glume muticous. Anthers 1.65–2 mm long. 2n = 20.

***Distribution, habitat and ecology*:** Said (Nat. Res. Council 1993) to have come originally from

India, now distributed world-wide, and much more common and wide-spread than suggested by herbarium material: Thailand, Malay Pen., Singapore, Sumatra (*Benecke* 276, sin. loc.; L), Java, Madura, Kangean Isl., Borneo (Kalimantan; Sabah), Philippines, Lesser Sunda Isl. (Sawu: *Proppe* s.n., L), New Guinea (Chimbu Province). Low damp sites, swamps, bogs, but persists when planted on a multitude of soils for perhaps centuries; at 0 to 1500 m altitude (probably higher, for cultivated in Chimbu, Papua New Guinea).

***Uses*:** The roots provide the vetiver oil used in perfumes and cosmetics. The fragrance resembles that of sandalwood and is long-lingering; used as a base in the more heavy oriental perfumes; in Malaya they are used in curries; roots used for weaving fragrant mats, fans, hats, etc. See the extensive discussion by Chadha [Wealth of India 10 (1976) 451]. Young leaves eaten by cattle, older ones eaten by carp. Used for thatching. The species is regarded as an eminent soilbinder with great potential in erosion control (Nat. Res. Council, 1993, where a large amount of information on many aspects of the species is given) and has been introduced as such all over the world in tropical to Mediterranean climates. However, in W. Sumatra, Central and West Java, the (illegal) harvesting of the roots resulted in a series of trenches across the landscape which subsequently eroded. This became such a problem that a number of provinces passed laws prohibiting the growing of the grass H. Siwon, Padang (pers.com.). A weak infusion or a paste of the roots is used as a febrifuge, a powder in bilious complaints. See also De Guzman & Oyen [PROSEA 19 (1998) 167–172, illus.].

***Vernacular name*:** Khas-khas, Vetiver (E.), akar wangi (Mal.).

***Notes*:** The epithet 'squarrosa' has been applied to this species based on *Andropogon squarrosus* L.f. [Suppl. Pl. (1781) 433], which is a dubious name possibly typified by Koenig in Hb. Linn. 1211-7, which is *Pseudoraphis spinescens* (R. Br.) Vickery [see Bor, Grasses (1960) 354].

There are two forms of *C. zizanioides*: a wild, flowering and seeding one thought to have originated in N India with shallow roots that contain the highly laevorotatory 'Vetiver oil', and a widely-cultivated, usually non-flowering and sterile one thought to origin from S India with deep roots that contain the dextrorotatry 'Oil of Vetiver roots'. Ramanujam & Kumar [Ind. J. Gen. & Pl. Br. 24 (1964) 144] have suggested that two species are involved, but indicate that there are 'not any gross morphological character' to differentiate between them. The characters they listed can only be seen in entire, living clumps, and are of little use in identifying herbarium material. These are not to be equated with *C. festucoides* and *C. zizanioides*, as the first, as far I have seen, occurs in India in Assam only, and is said to contain no oil. Kumar [Science & Culture 29 (1963) 152] reported a clone in which nearly all pedicelled spikelets had perfect florets. For the probable misapplication of *'V. nemoralis'* in Thailand for forms of this species, see under *C. festucoides*.

Non-Asian Species

17. Chrysopogon argutus (Steud.) Trin. ex B.D. Jackson , Ind. Kew. 1 (1893) 124, 530; 2 (1895) 704 (isonym); [*Chrysopogon argutus* Steud., Nomencl., ed. 2, 1 (1840) 360, based on *Rhaphis arguta* Nees in hb. Berol.: nomen]; *Andropogon argutus* Nees ex Steud., Syn. 1 (1854) 391; *Vetiveria arguta* C.E. Hubb., Kew Bull. (1939) 654. **Type:** Hb. Nees (holo: B, lost, fide H. Scholz, in litt.)

Andropogon squarrosus var. *chrysopogonoides* Hack., Mon. Androp. 6 (1889) 544; *Vetiveria zizanioides* var. *chrysopogonoides* A. Camus, Bull. Mus. Nat. Hist. Nat. Paris 25 (1919) 674. **Type:** *Bojer* s.n. (holo: W; iso: K).

***Distribution and Habitat*:** Mauritius, Rodriguez, river banks.

***Notes*:** The combination used above apparently has escaped bibliographers. For some reason Jackson gave Trinius ex Steud. as the author of the combination, the wrong reference (p. 360, must be 391), where Steudel has *Andropogon* (!) *argutus* Nees (!), and Australia (perhaps because Hackel l.c. 564 suggested that) as the

provenance. Still, the combination must be regarded as valid and correct.

18. Chrysopogon benthamianus Henr., Blumea 4 (1941) 532 [*Holcus gryllus* auct. non R.Br.: R. Br., Prod. 1 (1810) 199, pro descr. & specim.; *Chrysopogon gryllus* auct. non Trin.: Benth., Fl. Austr. 7 (1878) 537]. **Lectotype:** *R. Brown* 6189 (holo: BM, photo in BRI, photocopy in K; here proposed).

Chrysopogon fallax S.T. Blake, Univ. Queensl. Papers, Dept. Biology 2 (1944) 9, nom. superfl. **Type:** *S.T. Blake* 8108 (holo: BRI no. 8033; iso: K, NSW).

***Notes*:** The combination proposed by Henrard was the realization of a chance remark by Hubbard (1938) that Bentham (1878) (and others before and after him) had misidentified Australian specimens of an undescribed species with *Chrysopogon gryllus* (L.) Trin. Henrard based himself on Bentham's description and apparently for that reason called the species *C. benthamianus* Henr. Significant are his earlier statements (on *C. gryllus*): "The 5 subspecies of Hackel are at present accepted as distinct species" and he then enumerates *C. gryllus* s.s., *C. echinulatus*, *C. pallidus*, *C. glabratus* Trin., and *C. calcaratus* (Hack.) Henr. Then, "According to Hubbard, Bentham's *Chrysopogon gryllus* is a distinct species" and "the species which Bentham named *C. Gryllus* represents an undescribed species, while *C. Gryllus* var. *pallidus* (R.Br.) Benth. is also quite distinct. Bentham's *Chrysopogon Gryllus*, being described, we can give it another name *Chrysopogon Benthamianus*. nom. nov.", followed by a full and direct reference to Bentham (1878).

It is therefore obvious that Henrard excluded the reference to *Andropogon gryllus* L. and its type, and all combinations based on it and intended to rename the Australian taxon previously and erroneously called *C. gryllus* by Bentham and *H. gryllus* by R. Brown. Although Henrard said the species was described by Bentham in 1878, technically this is incorrect, for it was not in Latin, as required in 1941. However, indirectly he does refer to a Latin description, for Bentham cites the one given by R. Brown. It is therefore to be considered an 'error in bibliographic citation (Art. 33.3, see Ex. 6, 7)'. That Henrard called it a 'nom. nov.' is also an error to be corrected under Art. 33.4, see Ex. 9. It seems to me that the obvious type is the R. Brown collection on which the validating description was based. Some have suggested that it is part of the Bentham reference, and that all references given by Bentham are syntypes, so that *Brown* 6189 is a lectotype. To please those I have called it a lectotype above.

Because of the poor communications of those war times this species was described again independently by S.T. Blake (1944) as *C. fallax*. Vickery (1961) accepted Blake's species and regarded *C. benthamianus* as superfluous because a) Bentham would have described *C. gryllus* proper, b) his specimens would be a mixture of *C. fallax* and *C. pallidus*, and c) Henrard did not appoint a type.

As to the first, there is no Article that makes a name illegitimate because its description is faulty or does not even apply.

As to the second, Bentham recognized a variety *pallidus* next to his *C. gryllus*, and Henrard clearly excluded that (see above). In Vickery's time, a name based on discordant elements was a reason for its rejection, but as this is clearly against the type method, that Article (then 70) has been deleted from the Code since and cannot be invoked. There is no indication that Bentham's specimens would be such a mixture of two species, anyway. And even if it was, a lectotypification (also proscribed by the then Art. 70) according to Henrard's intentions could be made.

As to the third, for the name of a new taxon the appointment of a type was not required until 1958 (Art. 37.1).

Regarding Brown's descriptions, it is known that his 'species were ... described as collected in Australia itself, ... written out in the homeward voyage' (Hooker, 1890; cited by Stearn, 1960, p. xxv). This was apparently also the case in the present situation for he specifically mentioned that the lowermost leaf

sheaths are subsericeous. This is so in the Australian species, but not in *C. gryllus* from Europe. Blake, too, remarked that Brown's name referred to *C. fallax* '*as to the description and specimens*' (l.c., p. 13; emphasis mine).

As Blake stated that he included all that was cited, *C. fallax* is superfluous because it also included all the elements referred to by Henrard [Art. 52.1, and 52.2 (a)]. Blake, because he was unaware of Henrard's action correctly appointed a type (Blake 8108) for *C. fallax*, so this name, although superfluous, remains heterotypic from *C. benthamianus* under Art. 7.5.

19. Chrysopogon elongatus (R. Br.) Benth., Fl. Austr. 7 (1878) 538; *Holcus elongatus* R. Br., Prodr. 1 (1810) 200; *Sorghum elongatum* (R. Br.) Beauv., Agrost. (1812) 131, 164, 178; *Andropogon elongatus* (R. Br.) Spreng., Syst. Veg. 1 (1825) 287; *Rhaphis elongatus* (R. Br.) Chase, Contr. U.S. Nat. Hb. 24 (1925) 205; *Vetiveria elongata* (R. Br.) Stapf ex C.E. Hubb., Kew Bull. (1934) 444. **Type:** *R. Brown* 6193 [holo: BM, photo in BRI, K; iso: BRI; K, photo in BRI; MEL, photo in BRI].

***Distribution and habitat*:** Australia (Northern Territory to Queensland). Sea shores, dunes, mangrove, edge of marsh, moist *Melaleuca* stands.

***Uses*:** Grazed by cattle.

***Notes*:** The anthers of the sessile spikelet appear to be staminodial.This species was erroneously reported for Papua New Guinea by Reeder [J. Arn. Arb. 29 (1948) 360]. The material belongs to *C. micrantherus* Veldk. The two species may be distinguished as follows:

-. Panicle 28–30 cm long, pale yellow. Callus hairs 3.75–5.6 mm long. Column glabrous. Awn exserted to enclosed, straight to geniculate with contorted column and straight arista, 1.9–6.5(–8.25) mm long. Pedicelled spikelets 6.75–9.75 mm long. ..... *Chrysopogon elongatus*

-. Panicle 19–27 cm long, purplish. Callus hairs 1.8–3.6 mm long. Column puberulous. Awn exserted, geniculate with contorted column and straight arista, 5.25–14 mm long. Pedicelled spikelets 5.7–7.85 mm long. .... *Chrysopogon micrantherus*

20. Chrysopogon fulvibarbis (Trin.) Veldk., **comb. nov.**; *Andropogon fulvibarbis* Trin., Mem. Acad. Sc. St. Petersb. VI, 2 (1832) 287; *Vetiveria fulvibarbis* (Trin.) Stapf, Fl. Trop. Afr. 9 (1919) 158; *Anatherum fulvibarbe* (Trin.) Keng, Sinensia 10 (1939) 314; *Rhaphis zizanioides* subvar. *fulvibarbis* (Trin.) Roberty, Petite Fl. Ouest-Afr. (1954) 403, nom.inval.; *Chrysopogon zizanioides* var. *fulvibarbis* (Trin.) Roberty, Boissiera 9 (1960) 291. nom.ival. **Type:** *Sabine* 'Accra 19' in Hb. Trinius 0207.1 (holo: LE, IDC microfiche BT-16/1).

***Distribution and habitat*:** W Africa (S Mali, Ghana to Cameroon). Flood plains and savannas; at up to 300 m altitude.

***Notes*:** Oil has been reported for the roots [Burkill, Useful Pl. W. Trop. Afr. 2 (1994) 376]. The inflorescence branches have up to 6 spikelet groups, the callus is oblique, pungent, c. 1.6 mm long, and hairy, the up to 20 mm long awn is geniculate with a contorted puberulous column, making this an intermediate taxon between *Chrysopogon* and *Vetiveria*.

21. Chrysopogon gryllus (L.) Trin., Fund. Agrost. (1822) 188; *Andropogon gryllus* L., Cent. Pl. 2 (1756) 332; *Holcus gryllus* (L.) R. Br., Prodr. 1 (1810) 199 pro comb.; *Pollinia gryllus* (L.) Spreng., Pl. Pugill. 2 (1815) 10, comb. incorr. **Type:** *Séguier* s.n. in Hb. Linn. 1211.2 (holo: LINN, IDC microfiche).

***Notes*:** This species has been recorded for the Malesian area, based on misidentifications found in the literature:

It was noted for the Philippines (Luzon, Panay) by F.-Vill. [Nov. App. (1882) 316], which was possibly based on specimens of *C. nemoralis* [cf. Merrill, Enum. Philip. Fl. Pl. 3 (1923) 45], or *C. subtilis*, or something else altogether. It has been mentioned by De Castro [Garcia de Orta 12 (1964) 52] for Timor, but the species concerned is likely to have been *C.*

tenuiculmis Henr.,q.v. It has been recorded for Papua New Guinea (Central Province, Boku) by F.M. Bailey [Queensl. Agric. J. 23 (1909) 220; Ms. Schlenker s.n., n.v., not found in BRI, so perhaps not of a *Chrysopogon* (or *Vetiveria*) species]. It is not known to me what this may be, no *Chrysopogon* taxon is presently known from the Central Province of Papua New Guinea (other than *C. aciculatus*, of course).

22. Chrysopogon gryllus subsp. **echinulatus** (Nees ex Steud.) Cope, Kew Bull. 35 (1980) 701, map 1; Fl. Pakistan 143 (1982) 301; [*Rhaphis echinulata* Nees in Royle, Ill. Bot. Him. (1840) 417, nomen]; *Andropogon echinulatus* Nees ex Steud., Syn. 1 (1854) 397; *Chrysopogon echinulatus* (Nees ex Steud.) Wats. in Atk., Gaz. NW Ind. 10 (1882) 392; *Andropogon gryllus* L. subsp. *echinulatus* (Nees ex Steud.) Hack., Mon. Androp. (1889) 552. **Type:** *Royle* 226 (holo: LIV).

Notes: See introduction. *Rhaphis echinulata* Nees in Royle (1840) was not validly published, so the epithet with a different authorship ('Nees ex Steud.') dates from 1854. Cope's combination is to be regarded as a bibliographic error to be corrected (Art. 33.3) and is valid.

23. Chrysopogon nigritanus (Benth.) Veldk., **comb. nov.**; *Andropogon nigritanus* Benth. in Hook., Fl. Niger (1849) 573; *Andropogon squarrosus* var. *nigritanus* (Benth.) Hack., Mon. Androp. (1889) 544; *Vetiveria nigritana* (Benth.) Stapf, Fl. Trop. Afr. 9 (1917) 157; *Vetiveria zizanioides* var. *nigritana* (Benth.) A. Camus, Bull. Mus. Nat. Hist. Nat. Paris 25 (1919) 674; *Rhaphis zizanioides* var. *nigritana* (Benth.) Roberty, Petite Fl. Ouest-Afr. (1954) 403, nom.inval.; *Chrysopogon zizanioides* var. *nigritanus* (Benth.) Roberty, Bull. Inst. Franç. Afr. Noire 22 (January 1960) 106; Boissiera 9 (July 1960) 291, isonym. **Type:** *Vogel* s.n. (holo: K).

***Distribution, habitat and ecology*:** Tropical Africa; said to have been introduced elsewhere. Stream sides, swampy flood plains and other seasonally flooded places, somewhat salt-resistant, 0–100 m in Africa.

***Uses*:** Roots varyingly aromatic, probably according to edaphic conditions. Locally grown in Africa for its oil [Burkill, Useful Pl. W. Trop. Afr. 2 (1994) 375]. Young shoots eaten by cattle, older ones used for thatching and straw, said to repel termites. Sometimes grown as an ornamental in Africa. Good soil binder.

***Notes*:** Very similar to *C. festucoides*, q.v. This species has been reported for Sri Lanka [Clayton & Renvoize, Fl. Trop. E. Afr. Gram. 3 (1982) 739; but was not mentioned by Dassanayake et al., Rev. Handbook Fl. Ceylon 8 (1995) and earlier floras], Thailand, Malaysia, Philippines, but all these records are probably based on misidentified specimens of *C. festucoides* or *C. zizanioides*. For instance the specimens from Cambodia labeled as *V. zizanioides* var. *nigritana* by A. Camus in P are *C. zizanioides* s.s.

Because *C. zizanioides* is known to be cultivated in Africa, and since the differences with *C. nigritana* are so slight, they may easily be confused, and the uses attributed to *C. nigritanus* may well pertain to *C. zizanioides*. *Chrysopogon nigritanus* is a wild species which may be expected to seed freely; use of the species for soil binding is to be discouraged, as it will escape and become a pest.

Chrysopogon nigritanus within the *C. zizanioides*-complex is most similar to *C. festucoides*. For the differentials see under the latter species.

As Hackel (1889) cited var. *aristatus* Buse (now *C. festucoides*) with a query when he proposed var. *nigritanus*, the latter combination is therefore legitimate.

24. Chrysopogon oliganthus Veldk., **nom. nov.**; *Vetiveria pauciflora* S.T. Blake, Univ. Queensl. Pap. 2 (1944) 20, non *Chrysopogon pauciflorus* Vasey (1883). **Type:** *S.T. Blake* 8639 (holo: BRI).

***Distribution, habitat and ecology*:** Australia (W Australia, N Territory, Queensland). Locally vegetation forming in sandy river bed, edges

of swamps and creeks, in shallow water.

25. Chrysopogon rigidus (B.K. Simon) Veldk., **comb. nov.**; *Vetiveria rigida* B.K. Simon, Austrobaileya 3 (1989) 95, t. 10. **Type:** *J.R. Clarkson* 4419 (holo: BRI, holo, fragm. in L; iso: CANB, K, MBA, QRS).

***Distribution and ecology*:** Australia (Queensland, Cook District). Near waterhole in *Corymbia confertiflora* woodland.

Note: No taste to the roots (pers obs.)

Excluded names:

26. Chrysopogon fuscus (Presl) Trin. ex Steud., Nomencl., ed. 2, 1 (1840) 91, 360; *Andropogon fuscus* Presl, Rel. Haenk. 1 (1830) 342; *Sorghum fuscum* (Presl) Miq., Fl. Ind. Bat. 3 (1857) 503. **Type:** *Haenke* s.n. (holo: PR; iso: Hb. Trinius 211.03, LE, microfiche IDC BT-16/1)..

This is *Sorghum nitidum* (Vahl) Pers.

27. Chrysopogon leucotrichus A. Camus, J. Agric. Trop. & Bot. Appl. 11 (1955) 200. **Type:** *Schmid* 2461 (holo: P).

= **Capillipedium leucotrichum** (A. Camus) Schmid ex Veldk., **comb. nov**.

This combination was not validly published by Schmid [l'Agron. Trop. 13 (1958) 206] because there was no full and direct reference to the basionym as required by Art. 33.2.

28. Chrysopogon strictus (Nees) Jackson, Ind. Kew. 1 (1893) 95; 2 (1895) 704, both nom.inval., in synon.; *Rhaphis stricta* Nees in Hook., J. Bot. Kew Misc. 2 (1850) 99; *Andropogon leptanthus* Steud., Syn. 1 (1854) 391, non *Andropogon strictus* Host. (1802). **Type**: *Cuming* 1400 (holo: CGE; iso: L, P).

This is *Bothriochloa bladhii* (Retz.) S.T. Blake

This combination was not accepted by Jackson, as it is printed in italics and is equated with *Andropogon intermedius*, a synonym of *B. bladhii*.

29. Chrysopogon villosulus (Steud.) Watson in Atkins, Gaz. NW Prov. India 10 (1882) 392; Vidal [Phan. Cuming. Philip. (1885) 29, 158, nomen] Revis. Pl. Vasc. Filip. (1886) 291, isonym; *Andropogon villosulus* Nees ex Steud., Syn. 1 (1854) 397. **Syntypes**: *Royle* 93 (LIV, P), *Royle* 282 (LIV, photo in BRI; P).

This is *Capillipedium parviflorum* (R. Br.) Stapf.

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aci = *Chrysopogon aciculatus* (Retz.) Trin.

bor = *Chrysopogon borneensis* Henr.

cel = *Chrysopogon celebicus* Veldk.

fes = *Chrysopogon festucoides* (Presl) Veldk.

fil = *Chrysopogon filipes* (Benth.) Reeder

ful = *Chrysopogon fulvus* (Spreng.) Chiov.

int = *Chrysopogon intercedens* Veldk.

law = *Chrysopogon lawsonii* (Hook.f.) Veldk.

mic = *Chrysopogon micrantherus* Veldk.

nem = *Chrysopogon nemoralis* (Balansa) Holtt.

ori = *Chrysopogon orientalis* (Desv.) A. Camus

per = *Chrysopogon perlaxus* Bor

ser = *Chrysopogon serrulatus* Trin.

sub = *Chrysopogon subtilis* (Steud.) Miq.

ten = *Chrysopogon tenuiculmis* Henr.

ziz = *Chrysopogon zizanioides* (L.) Roberty

(T) = type collection

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Afriastini 1840: aci;Alston 14606: (fes); Anang 400: aci; 585: aci.

Backer 09/06/1927: (sub); 7: (fes); 51: aci; 89: (ziz); 2056: aci; 2563: aci; 4095: aci; 5144: aci; 5289: aci; 6408: aci; 6976: aci; 10054: aci; 10568: aci; 11112: aci; 11248: aci; 11948: aci; 12269: aci; 12977: sub; 13232: aci; 13975: aci; 13996: aci; 16914: aci; 17125: aci; 17271: aci; 17432: aci; 17786: aci; 18476: aci; 19222: aci; 19919: aci; 20428: (sub); 20593: ziz; 21266: sub; 21949: aci; 23033: aci; 23415: aci; 23510: fes; 23511: (fes); 23886: aci; 24064: aci; 24337: sub; 24625: sub; 26709: (ziz); 26974: aci; 27114: aci; 27683: (fes); 27698: ziz; 27760: (fes); 27775: (fes); 30016: ziz; 30055: sub; 30338: aci; 30750: sub; 30761: sub; 32511: fes; 33386: aci; 33387: aci; 35102: (fes); 36550: sub; 37270: ziz; Bakhuizen v.d. Brink 56: aci; 5753: aci; Barber 366: aci; bb (Ostwald 84) 9024: aci; Beguin 21: aci; 29: aci; 53: aci; 84: aci; 118: aci; 659: aci; K 3: aci; Belcher 859: fes; Benecke 276: ziz; Beumée 130: aci; 877: aci; 2652: aci; van Beusekom et al. 3816: ori; BF 801 (Borden): aci; Bloembergen 3071: aci; 3753: ten; Bor S-49: aci; Borden 801: aci; Bradley 48: aci; 49: ori; Brass 6045: mic; 6283: mic; 6426: aci; 8460 (T): fil; 8579 (T): mic; 22084: aci; 28156: aci; Brinkman 124: aci; Broekhuijsen 14: aci; Brooke 9816: aci; BS 4186 (Curran): aci; 7860 (Ramos): aci; 8749 (McGregor): aci; 11542 (Robinson): aci; 15751 (Clemens): fes; 18873 (McGregor): aci; 22238 (Santos): fes; 30964 (Ramos & Edano) (T): nem; 80771 (Ramos): ziz; Búnnemeijer 70: aci; 690: aci; 1227: aci; 1325: aci; 1405: aci; 1640: aci; 2492: aci; 3718: aci; 5595: aci; 7215: aci; 8251: aci; 11025: aci; Burcham 136: aci; Burkill & Shah 2514: ser; 3224: ser; 3227: ser; Burn-Murdoch 323: ori; Buwalda 2699: aci; 3359: aci; 4499: aci; 5800: aci; 7868: aci; 7885: ziz.

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Pengklai & Smitinand 1140: ori; Pételot 245: ziz; Phengklai & Smitinand 6085: law; Phil. Pl. 118: ziz; 575: aci; Pitlo 38: aci; Pleyte 911: aci; PNH 2965 (Convocar): aci; 32944 (Sulit): ziz; 40256 (Edano): sub; Poore 513: ziz; Popta 00159/40: ziz; Posthumus 1885: aci; 2298: aci; 2625: aci; 2669: aci; Powell 478: aci; Proefst. Javasuikerindustrie 60: aci; Dj. 10: aci; Pulsford 5: aci; Put 2576: ziz; 2593: fes; 4103: ziz; 4104: ziz; 4233: ori.

Rahmat si Toroes 261: aci; Ramos 1617: aci; 1833: aci; 1948: aci; Rao et al 95: aci; Rappard 237: sub; Reeder 812: aci; Rensch 102: aci; 235: (ten); Resident Timor 5: aci; 9: aci; Ridley 5-1890: ori; 11-10-1890: aci; C. 1896: ziz; 14/2/1917: ori; 3: ori; 2137: nem; van Rijckevorsel 5: aci; Robinson 12/1916: ori; Pl. Rumph. Amb. 45: aci; 6408: ser; Rodway 2569: aci; Roesil 589: aci; 723: aci; 901: aci; Rostados 2-1904: (aci); van Royen 4933: aci; Ryves KS95/079: ori.

Sands 615: aci; Santos 4002: ziz; 4003: ziz; 4187: aci; 4899: aci; 4953: aci; 5137: ser; 6243: aci; 6311: ser; de la Saviniére 83: aci; Sawyer 144: aci; 163: aci; Schiffner 35: ziz; 1500: aci; Schmutz 5444: ten; 5756: ten; Schodde & Craven 4593: aci; Seidenfaden 2219: (aci); SF 649 (Haniff) (T): ser; 2958 (Haniff & Nur): ori; 4634 (Burkill): aci; 6236: ziz; 11527 (Machado): (aci); 12512 (Burkill & Haniff), p.p.: aci; 12742 (Burkill & Haniff): aci; 15175 (Holttum): ori; 20476 (Henderson): aci; 20825 (Holttum): nem; 24600 (Holttum): aci; 25803 (Corner): ori; 25805 (Corner): aci; 25846 (Corner): nem; 29058 (Henderson): ori; 29784 (Corner): ser; 29905 (Corner): ori; 33257 (Spare): aci; 37840 (Holttum): ori; 38104 (Corner): ziz; 39060 (Sinclair): ziz; 39810 (Sinclair & Kiah): ori; Simpson & Forman 89/125: aci; van Slooten 2435: sub; E. Smith 932: aci; Sinclair 5364: aci; 7530: ori; Sirirugsa 842: aci; Smith H.M. 210: ori; Smitinand 5044: fes; 5932: ziz; 6078: ziz; Smitinand & Hambananda 8477: ori; Soares 701: (aci); 730: (aci); Sohns 00/00/1920: aci; Sørensen et al. 1964: 2060: aci; (aci); 2105: ?fes; 3700: aci; 5768: ziz; Squires 886: aci; 809: ziz; van Steenis 584: aci; 1037: aci; 3127: aci; 6733: aci; 18652: (aci); Suvathubandhu 25: aci.

Tandom 4934: aci; Teysmann 5947: (ten); Tsang 29315: aci.

Ultée 3: aci; 17: aci; Uway et al. PTU. 22: aci.

Vanoverbergh 2808: aci; 3791: ziz; Veearts Sibolga 5: aci; van der Veen 60: (ten); Veldkamp 8757: aci; Verboom 24: ser; Verdcourt 5206: aci; Verheijen 2456: ten; 2801: ten; Versteegh 83: aci; Vesterdal 85: ori; 457: ziz; Vidal 1962: aci; de Vogel 3048: aci; Volkens 117: (aci); de Voogd 2658: (ten).

Walsh 19: aci; Weber 1047; aci; Whitford 385: aci; Whyte 5/1974: ori; Williams 94: aci; 2840: aci; Winckel 122: aci; 596: aci; 1016: aci; Winkler, Hubert 2931: aci; Wiriadinata 414: ten; Wong P.W. 4 Aug 1959: aci; Worthington 12376: aci; Wray 765: aci.

Yapp 359: ori.

Zollinger 54: aci; 2815 (T): sub.

The *Hygrocybeae* (Fungi, Basidiomycota, Agaricales, Hygrophoraceae) of the Lane Cove Bushland Park, New South Wales

A. M. Young

Summary

Young, A.M. (1999). *Austrobaileya* 5(3): 535-564. The Australian species of tribe Hygrocybeae within the Lane Cove Bushland Park of Sydney, New South Wales are discussed and two genera are recorded: *Hygrocybe* (Fr.) Kummer; and *Camarophyllopsis* Herink. Eighteen taxa are included, with three new species and a new variety described: *Hygrocybe austropratensis, H. lanecovensis, Camarophyllopsis kearneyi* and *Hygrocybe anomala* var. *ianthinomarginata*. The data for a fifth undescribed taxon is included to facilitate its identification and the collection of sufficient material for a holotype. Photographic material indicates that at least another three taxa may be present in the area. *Camarophyllus lilacinus* (Cleland & Cheel) is transferred to *Hygrocybe* (Fr.) Kummer under the new name *Hygrocybe cheelii* nom. nov. The relationship of *Hygrocybe graminicolor* (Horak) May & Wood with *Gliophorus pallidus* Horak and *Hygrocybe batesii* A. M. Young is discussed and both *Gliophorus pallidus* and *Hygrocybe batesii* are reduced to synonymy with *Hygrocybe graminicolor*. Keys, descriptions and line drawings are provided to facilitate identification.

Key words: Hygrophoraceae, Hygrocybeae, *Hygrocybe, Camarophyllopsis*, *Hygrocybe austropratensis, H. cheelii, H. lanecovensis, H. anomala* var. *ianthinomarginata, Camarophyllopsis kearneyi.*

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The Lane Cove Bushland Park

The initial paper on the Australian Hygrophoraceae Lotsy (Young and Wood 1997) defined 57 taxa. Ongoing field work during the 1998 season has added considerable information about this agaric family for south eastern Australia. The Gore Creek gully of the Lane Cove Bushland Park – 5.7 km north west of the centre of Sydney, New South Wales – was found to have at least 18 taxa belonging to tribe Hygrocybeae Kühner within a very small and roughly rectangular area approximately 150 metres long and 50 metres wide. Photographic records indicate that there may be as many as 20 to 25 taxa belonging to family Hygrophoraceae at the location. The Gore Creek site is unusual for the Sydney region in that it remains one of the few places where both sides of a gully have been preserved from housing development with consequent retention of the closed canopy that appears to be essential for the preservation of the forest Hygrophoraceae. The presence of so many taxa in such a small area suggests that although the locality is heavily impacted by human passage, the soils seem to have remained relatively pollutant free.

Gore Creek is a natural, permanent waterway which runs directly into Sydney Harbour. The aspect of the creek is mostly north-south so that the site is shielded from afternoon sun intensity and receives less sunlight than the surroundings during winter.

The collection site is within an often steep sided gully drained by Gore Creek but the gully bottom has flat areas built up of sandy soils classified as 'Hawkesbury landscape soils' after the sandstone substrates from which they are primarily derived, although the creek does receive some drainage from richer shale soils found in its upper reaches or sometimes on the gully sides. The gully soils are usually greater than 50 cm deep and are naturally low in fertility (Chapman and Murphy 1989). The 'softness' of these alluvial soils coupled with the often heavy rainfall of the area means that considerable erosion can take place if interference (whether natural or human

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induced) with the vegetation of the creek banks takes place. Where the creek runs through these soft alluvial soils, steep banks (1–2 metres high) can occur naturally.

The vegetation structure of the Gore Creek gully site is that of a gallery warm-temperate rainforest (Williams, Harden and McDonald 1984) centred on the creek with enclosing and protective myrtaceous woodlands/forests situated on the gully walls. Gallery warm-temperate rainforests are extremely specialised: they form narrow bands of closed canopy forest with central creeks in a 'tunnel-like core' and are usually found on poor soils. They have a much reduced epiphyte content and generally, as here, contain only a small number of canopy tree species (3–15). They are not the equivalent of sub-tropical rainforests which contain many more canopy tree species (10–60), have extensive epiphytic floras, are found on rich soils and are not tied to creek margins. These gallery rainforests are also found in the plateau of the Hornsby–Hawkesbury area directly north of Sydney and they are often situated within the deep gullies that run down from that sandstone plateau. They exist first, because the sites are protected from the very dry conditions of the plateau summit and second, because the gully soils are nutrient enriched by water run-off. This second condition is of critical importance because the Hawkesbury sandstone, which forms much of the substrate for this region, is extremely lacking in nutrients.

The dominant vegetation in the Hygrocybeae site is a closed forest of 'lilly pilly' *Acmena smithii* (Poir.) Merrill & Perry, 'grey myrtle' *Backhousia myrtifolia* Hook. f. & Harv., 'cheese tree' *Glochidion ferdinandi* (Müll. Arg.) F. M. Bailey and 'sweet pittosporum' *Pittosporum undulatum* Vent. Coachwood, *Ceratopetalum apetalum* D. Don is also present (Armitage and Klaphake 1996). Under the closed canopy, a lower layer of ferns is distributed randomly beside the creek and on its steep banks. The tree species listed above form the core of the gully vegetation and are primarily responsible for inducing the extremely favourable humid microclimate upon which the fungi depend, however these trees in turn are dependent, at least partially, upon the presence of the open sclerophyll forest which lines the gully sides and which acts as a 'buffer zone'. Both sides of the gully are covered in eucalypt open woodland and forest growing on the sandstone or shale soils and producing a dense layer of litter. The dominant species on these slopes belong to the Myrtaceae and include 'blackbutt' *Eucalyptus pilularis* Sm., 'Sydney red gum' *Angophora costata* (Gaertn.) Britten and 'turpentine' *Syncarpia glomulifera* (Sm.) Niedenzu (Armitage and Klaphake 1996). Considerable light reaches the woodland or forest floor on the gully sides.

The more or less coastal climate of the region is humid and temperate. No records are kept specifically for the park area, however full weather details are maintained for the Riverview Observatory 2 kilometres west of the park site. These records are considered to be directly applicable to the park and they show an average annual rainfall of 1137 mm. The rainfall for the months of May, June and July average 106, 118 and 87 mm respectively while no month of the year has an average rainfall of less than 63 mm. Minimum and maximum temperatures for these months are: May 9.7, 19.5; June 7.5, 17.0; July 6.1, 16.6 degrees Celsius. From observations concerning the climatic requirements of the Hygrophoraceae within Australia, the weather conditions and the associated microclimate of the gulley are most favourable for these fungi and at least partially account for the species diversity of the Hygrophoraceae at this site.

Materials and Methods

For most taxa, a number of collections from the Lane Cove Bushland Park are held, however since these mostly duplicate previously known information, only a representative sample of two or three exemplar collections is listed here. On occasion, material from outside the Lane Cove Bushland Park is cited where this addition provides an important extension of a taxon's geographical range, where no material is held for taxa that are definitely known to occur on the Gore Creek site, or where the listing was considered essential for purposes of taxonomic revision.

For all material collected by the author, colours of the fresh basidiomes were referenced

to Kornerup and Wanscher (1981). Colour references are missing for other collections. Material was preserved by air drying. Habitat details are supplied for the taxon as generally known (Young and Wood 1997) with specific reference to the Lane Cove Bushland Park occurrence where necessary. Holotype material for the newly described taxa is deposited at the Orange Agricultural Institute Herbarium (DAR), Orange, New South Wales.

All light microscopy was completed on an Olympus CX40 microscope with drawing tube attachment and calibrated with an Olympus 1 mm slide. Hand sections of dried material gave best results and these were re-constituted in ammoniated congo red. Pileipellis transverse sections were always taken radially in order to examine both the centre and marginal surfaces.

Illustrations are provided for the new taxa and for those species which are either not covered by relevant illustrations in Young and Wood (1997) or which require additional diagrams as a result of new information. Where present, the habit sketch and transverse section show basidiome dimensions and lamellae attachment; both are referenced to a 1 cm scale bar. For the microscopic drawings, the pileal, hymenophoral tramal or stipital structures are not shown here unless they are exceptionally unusual because they usually conform to standard forms (see Young and Wood 1997). For each illustrated specimen, 20 spores and 10 basidia were selected at random, drawn and measured. Cystidia were drawn if present. A 10 µm scale bar is placed beside each drawing of a microcharacter.

The derived measurement 'Q' is defined as the quotient of the mean length divided by the mean width for the relevant spore or basidial measurements. The range of Q for each taxon is derived from the combined results of all collections. In practice it has been found that the values of the spore mean for most collections will not vary more than ±0.5 µm from the values given here; the mean Q for the spores seems to vary by a lesser amount and most collections seem to be within a value ±0.3 from that given here. The values for the basidial length and width means and mean Q's should be applied similarly.

The previous paper by Young and Wood (1997) used a derived parameter 'R' which was defined as the quotient of the mean basidial length and the mean spore length of the taxon. This parameter has been discarded. Further studies have shown that the results for R vary so much between collections that a reasonably stable reference value cannot be established for any one taxon. The large variations are due to the fact that relatively minor alterations in mean spore length produce quite large changes in the derived quotient.

Herbaria

Herbaria which made material available for this study (or at which material is deposited) are:

UNSW: School of Biological Sciences, University of New South Wales, Kensington, NSW, Australia.

DAR: Orange Agricultural Institute Herbarium, Orange, NSW, Australia.

PDD: Herbarium PDD, Manaaki Whenua Landcare Research, Auckland, New Zealand.

AD: State Herbarium, SA, Australia.

Comments

The taxa listed or newly described in this paper represent a large percentage of the species present, however it is known that more than the eighteen taxa presented here, do occur at the site. Photographic records exist of a grey taxon with a 'tricholomatoid' appearance but with very thick and distant lamellae; supporting information suggests that this taxon will be allocated to genus *Hygrocybe*. There is also a bright yellow, dry taxon with deeply decurrent lamellae which may belong to the Hygrophoraceae. The 'coachwood collections' belonging to genus *Camarophyllopsis* were considered sufficiently close at this stage to warrant their placement with the new taxon described from fern banks beside the central creek, however further work may show the coachwood material does represent a separate species. Other taxa are likely to appear given sufficient time for further collections at the site: for example, a photographic slide exists of a fungus found at Gore Creek which is likely to

be *Hygrocybe miniata* (Fr.: Fr.) Kummer, a species that is reasonably common in the Sydney region.

One of the most spectacular species in the Gore Creek area is *Hygrocybe graminicolor*. This forms troops in the litter of the eucalypt woodland or forest and is quite common. An interesting aspect of its occurrence is that it often appears in the deep litter just below a sandstone 'overhang'. These overhangs are sandstone outcrops on the gully walls where water drips or spills over (sometimes in miniature waterfalls) during heavy rain. The overhang concentrates rain run-off so that the litter below is kept very moist during the mycelial growth season. These 'drip areas' also occur in the Blue Mountains National Park and they were deliberately sought when collecting Hygrophoraceae as experience showed that the associated litter zone usually provided much richer fruitings of any fungal species present in the area.

The poor sandy soils of the park seem to be ideal for the growth of the Hygrophoraceae. Troops of the various red taxa are frequently found on the sheltered sites near the creek and also in moss crevices along the walls of the creek banks. The species *Camarophyllopsis kearneyi* Young grows along the creek banks but so far has only been collected from the bare soil between clumps of fern and under a dense layer of their fronds.

Fruiting appears to begin about mid May and then continues until mid July with a few basidiomes appearing in August if conditions remain perfect. This fruiting of the Hygrophoraceae is now thought to be more or less consistent throughout the south eastern coastal area of Australia from the Sydney region to Tasmania: the collection data for 1998 suggests that when the Hygrophoraceae are fruiting in Tasmania, the same taxa will also be fruiting in Victoria and New South Wales. Generally, basidiomes of the Hygrophoraceae appear later in the season than do many other agarics and then continue to be produced until either heavy frost or lack of rain bring the season to an end. Exactly what triggers the start of fruiting is still not certain.

It is also interesting to compare the occurrence of the Hygrophoraceae of the Gore Creek site with the occurrence of similar or the same taxa in Tasmania and elsewhere in eastern Australia. Collecting during 1998 in various forest areas of Tasmania demonstrated that the Hygrophoraceae in that state occur almost exclusively in the beech forests {*Nothofagus cunninghamii* (Hook. f.) Oerst.} and particularly in the deep moss beds that are found on those forest floors. Open forest was ignored as previous experience had shown that few Hygrophoraceae, if any, occurred in those areas. In Victoria and New South Wales, basidiomes were found abundantly in soil and litter in moist eucalypt forests or subtropical or warm temperate rainforests. The type locality of the Queensland taxon, *Hygrocybe iropus* Young, is a dry sclerophyll woodland on a very exposed and open bluff in the Bunya Mountains. The microhabitats of the various Gore Creek taxa are comparable with elsewhere in southern Australia in that various species are found on bare soil or amongst short moss in the gallery rainforest, but other species {for example *Hygrocybe virginea* (Wulfen.: Fr.) Orton & Watling} will mostly or always be found in the eucalypt litter areas of the gully walls.

The Gore Creek site collections have assisted enormously in developing better species concepts for some of the taxa published in the first paper on the Australian Hygrophoraceae (Young and Wood 1997). This first paper was largely produced from herbarium material assisted by associated field notes and photographic material because the drought conditions largely dominating Australia during that paper's development were not conducive to field work on the Hygrophoraceae. Many species of the Hygrophoraceae have a wide range of colours and other macrocharacters and some are now known to have basidiomes that change colours as they mature. It is now recognised that one of the published taxa, *Hygrocybe batesii*, was described from good collections made of the species *Hygrocybe graminicolor* when it was exhibiting colour characters at one end of its range of variations and this paper corrects that error. Conversely, other taxa (eg. *Hygrocybe aurantipes* A. M.

Young) have been shown to be remarkably stable in colour and in both macro- and micro-characters so that the description has required little, if any, additional information.

Taxonomy

Family **Hygrophoraceae** Lotsy Vortr. Bot. Stammesg. **1**: 706 (1907).

Basidiome small to medium sized, stipitate. Pileus conical, convex, umbilicate or infundibuliform; sometimes perforate; surface dry, moist, viscid or glutinous and may be smooth to squamulose or fibrillose. Lamellae generally thick, waxy, and distant; free or adnexed to decurrent. Stipe central, often brittle, with similar surface moisture or structures to pileus. Universal veil generally absent. Context soft, frequently thin, waxy and translucent. Spore print white, cream, pale violaceous or magenta. Spores small to large, smooth rarely nodulose or echinulate, subglobose to ovoid, ellipsoid or cylindrical, sometimes constricted, hyaline or rarely with dark contents, inamyloid rarely amyloid. Basidia often long and narrow. Cheilocystidia sometimes present, pleurocystidia rare. Hymenophoral trama regular, irregular or bilateral. Pileipellis a cutis or trichoderm (sometimes gelatinised or glutinous) or rarely a hymeniderm. Development gymnocarpic, occasionally hemiangiocarpic. Terrestrial rarely lignicolous, mycorrhizal or saprophytic. **Type**: *Hygrophorus* Fr.

Key to the Tribes of *Hygrophoraceae*

1. Lamellae with regular to irregular trama, never divergent ..... **Hygrocybeae** Kühner
   Lamellae with divergent trama ..... **Hygrophoreae** P. Henn. (not considered further.)

Tribe **Hygrocybeae** Kühner, Bull. mens. Soc. linn. Lyon **48**: 621 (1979).

Hymenophoral trama regular to irregular; not forming ectomycorrhizae.

Type: *Hygrocybe* (Fr.) Kummer.

Key to the Genera of *Hygrocybeae*

1. Pileipellis composed of hyphae forming a cutis, ixocutis, trichoderm or ixotrichoderm of non-inflated, hyphal elements ..... **Hygrocybe**
   Pileipellis an hymeniderm but sometimes approaching an epithelium and then composed of inflated elements ..... **Camarophyllopsis**

1. Hygrocybe (Schaeff.: Fr.) Kummer, Führ. Pilzk.: 26 (1871); *Hygrocybe* Fr., Syst. Myc. **1**: 101 (1821); Camarophyllus Fr., Syst. Myc. **1**: 98 (1821); *Camarophyllus* (Fr.) Kummer, Führ. Pilzk.: 2 (1871). **Type:** *Agaricus conicus* Schaeff., Fungi Bavariae **4**: 2 (1774).

Basidiome fleshy, often watery or waxy in texture, collybioid, mycenoid or omphaloid, generally small to medium sized but occasionally large; variously coloured, often bright red, orange, yellow, green and lilac or combinations of these colours; pileus opaque or hygrophanous, striate or not, dry to glutinous, smooth to squamulose or fibrillose; lamellae usually sub-distant to distant, free to adnate or decurrent, thick to very thick and with waxy appearance when fresh; velar structures absent; stipe dry to glutinous, smooth to squamulose or fibrillose; spore print white, cream coloured, pale magenta or pale lilac. Spores hyaline, smooth or rarely spinose, non-amyloid (for known Australian taxa); basidia sometimes long (25–70μm), Q: 2.5–10.0,

2-and 4-spored forms frequent; cheilocystidia present in some species either as true or pseudo-cystidia; pleurocystidia rare and then as pseudo-pleurocystidia; lamellae trama regular, subregular to irregular, tramal elements from very long (> 1000 µm) to very short (< 30 µm); clamp connections usually present; pileipellis a cutis, ixocutis, trichoderm or ixotrichoderm. Development gymnocarpic and stipitocarpic.

***Habitat and Distribution*:** Solitary to gregarious, terrestrial rarely on wood and then only if extremely rotten; substrates include soil, humus, moss; grasslands to forest and saprophytic. Cosmopolitan from subarctic or subantarctic to tropics and alpine regions.

Key to the Subgenera of *Hygrocybe*

1. Hymenophoral trama irregular, composed of short (20–150 µm) interwoven hyphal elements; basidiome often with subdued colours (white, brown, lilac-grey) but may be orange,apricot or bright lilac; lamellae arcuate to decurrent; clamps frequent throughout the basidiome, occasionally rare in the hymenophoral trama ..... subgen. **Cuphophyllus** Key 1
   Hymenophoral trama regular to subregular (if subregular, then basidiome brightly coloured) and composed of parallel hyphal elements which are either 'long tubular' or chains of short elements; basidiome often very brightly coloured (red, orange, yellow, green, lilac); lamellae variously attached;clamps usually frequent throughout the basidiome or at least at the bases of the basidia..... 2

2. Hymenophoral trama very regular, composed of very long (1000–3000 µm), aseptate, tubular elements with tapered ends; lamellae free, ascending or narrowly adnate; tissues may blacken on bruising; basidia usually short (mean length 30–40 (–45) µm); except for the aseptate hymenophoral trama, clamps usually present throughout the basidiome, rarely absent in some taxa with 2-spored basidia ..... subgen. **Hygrocybe** (Key 2)
   Hymenophoral trama regular to subregular, composed of parallel chains of short, sometimes inflated hyphal elements (usually 20–400 µm); lamellae adnate to decurrent; tissues never blackening on bruising; basidia sometimes long (40–60 µm); clamps either present throughout the basidiome present only at the bases of the basidia 3

3. Clamps present throughout the basidiome and of medallion form or not; pileus never splitting radially so that the split occurs along the medial section of a lamella ..... subgen. **Pseudohygrocybe** (Key 3)
   Clamps absent throughout the basidiome except at the bases of the basidia and then frequently of medallion form; pilei tending to split radially along the medial line of at least some lamellae so that the half lamellae remain joined at the lamellae margins and also attached to the pileus at the edges of the radial split ..... subgen. **Humidicutis** (Key 4)

Key 1: Species of Subgenus *Cuphophyllus*

1. Pileus white to slightly greyish, sometimes with brownish centre ..... **5. H. virginea**
   Pileus mauve to lilac, pinkish lilac, lilac brown, orange, orange brown or apricot orange 2

2. Pileus mauve, pinkish mauve, lilac or lilac brown 3
   Pileus orange, orange brown, or apricot orange 4
3. Pileus bright pinkish mauve or lilac, never hygrophanous;
   stipe yellow at the base . . . . . **3. H.cheelii**
   Pileus pale lilac to lilac grey, usually rather hygrophanous
   and drying pallid buff with lilac tints; stipe never yellow at
   the base . . . . . **4. H. reesiae**

4. Pileus apricot orange; basidiomes slender and thin fleshed;
   always smooth; lamellae interveined; spores 5–6 x 4–5 µm . . . . . **1. H. aurantiopallens**
   Pileus yellow orange to light orange brown; basidiomes stout;
   at first with whitish furfuraceous coating over much of the surface
   and often with residues at the margins; lamellae without interveins;
   spores 6–8.5 x 5–7 µm . . . . . **2. H. austropratensis**

Key 2: Species of *H.* subgen. *Hygrocybe*

1. One species known in the area: pileus conical, often red or
   yellow; all tissues rapidly blackening on bruising and exuding
   a pale, watery yellow fluid if cut; pileal and stipe surfaces
   covered in abundant, blackish fibrils. . . . . **6. H. astatogala**

Key 3: Species of *H.* subgen. *Pseudohygrocybe*

1. Pileipellis a dry cutis or trichoderm (rarely a very weak
   ixocutis demonstrated only by microscopic examination of
   gelatinisation of surface hyphae) 2
   Pileipellis a well developed ixocutis or ixotrichoderm (while
   in some mature basidiomes the viscidity may not be apparent,
   the nature of the ixocutis is always clearly apparent in juvenile
   basidiomes and can be restored in dry adult basidiomes by applying
   a small drop of distilled water). 6

2. Pileipellis a trichoderm at least at the centre and appearing
   finely velvety or tomentose as the pileus matures and dries;
   pileus and stipe deep red to orange, lamellae cream coloured
   to pale yellow. . . . . **9. H. cantharellus**
   Pileus a cutis (rarely a very weak ixocutis demonstrated
   microscopically), pileus, stipe and lamellae variously coloured 3

3. Lamellae pale to very pale lilac; pileus light orange brown and
   often with pallid lilac margins; spinose spores found occasionally
   at random amongst the normal spores . . . . . **7. H. anomala**
   Lamellae white or a shade of yellow; pileus olive brown or red,
   stipe red or yellow; spinose spores never present 4

4. Pileus olive brown; stipe bright yellow or yellow orange . . . . . **8. H. aurantipes**
   Pileus and stipe bright red 5

5. Pileus brilliant red with yellow, striate margins; lamellae deeply
   decurrent and bright yellow; most spores strongly constricted. . . . . **17. H. sp. LC1**
   Pileus red but without the yellow, striate margins; lamellae adnate,
   adnate with a decurrent tooth or arcuate and white to pallid yellow

or cream coloured with faint brownish tints; constrictions present in only a few spores ..... **13. H. kula**

6. Basidiomes completely bright chrome yellow ..... **10. H. chromolimonea**
   Basidiomes not completely bright chrome yellow 7

7. Pileus red 8
   Pileus green, yellow green or a shade of brown 9

8. Lamellae deeply decurrent and pure white becoming pale yellow with age; stipe red ..... **14. H. lanecovensis**
   Lamellae broadly adnate with at most a decurrent tooth, creamy yellow to pinkish yellow; stipe clear yellow to yellow orange ..... **11. H. erythrocala**

9. Cheilocystidia absent and lamellae margins without a gluten thread;lamellae usually adnate or with a decurrent tooth; spore mean length 7.5–8.5 µm ..... **15. H. stevensoniae**
   Cheilocystidia present and embedded in a gluten thread; lamellae always arcuate to deeply decurrent; spore mean length 6.0–7.0 µm .. **12. H. graminicolor**

Key 4: Species of *H.* subgen. *Humidicutis*

1. One species known in the area; basidiomes wholly lilac; pileus conical to umbonate, usually splitting radially with the splits severing the lamellae along the medial trama; clamps absent throughout the basidiome except at the bases of the basidia ..... **16. H. lewellinae**

Camarophyllopsis Herink, Acta Mus. Horti Bot. Boh. Bor. **1**: 61 (1958). **Type:** *Camarophyllopsis schulzeri* (Bres.) Herink.

Basidiome thin to fleshy, small, dull coloured in grey to ochre or brown; pileus convex to umbilicate, dry and often hygrophanous; lamellae distant, broadly adnate to arcuate or decurrent; universal veil absent; stipe dry, often with small dots, pruinose punctate or fibrillose; spore print white. Spores hyaline, smooth, non-amyloid, subglobose to broadly ellipsoid, small (up to 7 µm long); basidia narrowly clavate, 20–70 x 4.5–8.5 µm, Q: 4.5–10.0, mostly 4-spored; cystidia absent or inconspicuous; hymenophoral trama regular to subregular and composed of short elements up to 170 µm long; pileipellis an hymeniderm; clamp connections present or absent; development monovelangiocarpic and stipiticarpic.

***Habitat and distribution*:** Solitary to subgregarious, terrestrial in forests or open sites, apparently saprophytic. Mostly in temperate North America, Asia and Europe, but also known from subtropical South America and Asia.

1. One species known in the area; basidiomes inconspicuous, brownish grey, with fibrils on the stipe; pileipellis composed of globose elements and giving the pileal surface a micaceous effect under a hand lens; lamellae whitish or greyish white and adnate to arcuate; in troops on soil under low ferns ..... **18. C. kearneyi**

Field Key to the Hygrocybeae of Lane Cove Park

These 'artificial' keys use macro-characters which are either easily seen with the naked eye or can be readily determined with a x10 hand lens. They have been constructed so that those

taxa which tend to lose their viscidity as maturation proceeds are included in both the group of distinctly glutinous taxa and the group of completely dry taxa.

Key to the Groups

1. Pileus viscid or glutinous ..... Key 1
   Pileus dry 2

2. Basidiomes (at least in part) brightly coloured: red, orange, yellow, lilac ..... Key 2
   Basidiomes dull coloured (brown, grey, black) or white ..... Key 3

Key 1 - Pileus Viscid or Glutinous

1. Basidiome wholly bright chrome yellow ..... **10. H. chromolimonea**
   Basidiome green, brown or red 2

2. Pileus brilliant red/crimson 3
   Pileus green or greenish brown, yellow brown or brown 4

3. Lamellae white becoming yellowish with age, deeply decurrent; stipe red ..... **14. H. lanecovensis**
   Lamellae cream yellow, usually with pink tints, adnate with at most a decurrent tooth; stipe yellow or yellow-orange ..... **11. H. erythrocala**

4. Lamellae margins never with sticky, glutinous thread (use a x10 hand lens) ..... **15. H. stevensoniae**
   Lamellae margins always with a sticky, glutinous, often greyish thread (use a x10 hand lens) ..... **12. H. graminicolor**

Key 2 - Pileus Dry, Basidiomes Brightly Coloured (at least in part)

1. Basidiomes either with more or less strong lilac or mauve colouration generally over the whole fruiting body or with the lamellae only delicately but distinctly lilac tinted or with both lamellae and the pileus margins lilac tinted 2
   Basidiomes completely lacking in lilac or mauve colours or tints 5

2. Delicate lilac tints present either only on the lamellae or on both the lamellae and the pileus margins, pileus orange brown ..... **7. H. anomala**
   Lilac or mauve colouration found generally over the entire fruiting body, the basidiome is often very intensely coloured 3

3. Pileus conical to umbonate and frequently splitting radially along the medial section of the lamellae; lamellae free, adnexed or narrowly adnate ..... **16. H. lewellinae**
   Pileus convex and may become umbilicate, not splitting radially; lamellae decurrent 4

4. Basidiomes an intense pinkish mauve or lilac; stem base distinctly yellow; pileus finely velvety under a x10 hand lens ..... **3. H. cheelii**
   Basidiomes pale to intense lilac but without the pink tints; stem base never yellow; pileus smooth under a x10 lens ..... **4. H. reesiae**

5. Pileus dark olive brown becoming paler with age and often

showing yellow, greenish or orange tints; stipe bright yellow to yellow orange ..... **8. H. aurantipes**
Basidiomes not with the above pileus and stipe colour combination 6

6. Pileus bright orange to orange brown 7
Pileus red, or red bruising black 10

7. Basidiomes wholly apricot orange, the lamellae may be a slightly paler shade ..... **1. H. aurantiopallens**
Basidiomes not wholly apricot orange; lamellae cream coloured or yellowish; if pale orange brown then fruiting bodies stout and with deeply decurrent lamellae 8

8. Stipe thick (4–5 mm); pileus orange brown; both pileus and stipe with a white, furfuraceous layer when immature and which is lost as the fruiting body expands ..... **2. H. austropratensis**
Stipe slender (1–3 mm), pileus orange; basidiomes without the white furfuraceous layer on both pileus and stipe when immature 9

9. Pileus finely velvety tomentose at least at the centre (use a x10 hand lens); lamellae deeply decurrent, at first white then becoming a shade of yellow; stipe red with yellow base ..... **9. H. cantharellus**
Pileus smooth; lamellae arcuate decurrent and yellowish brown or buff; delicate lilac tints are usually present on the lamellae; stipe orange..... **7. H. anomala**

10. Lamellae ascending to broadly adnate with at most a decurrent tooth 11
Lamellae strongly decurrent 13

11. Pileus conical with abundant black fibrils; all tissues bruising black..... **6. H. astatogala**
Pileus convex without black fibrils; no tissues bruising black..... 12

12. Lamellae at first white, then becoming pallid yellow with age; stipe red..... **13. H. kula**
Lamellae cream coloured from the start and then with pinkish tints; stipe yellow or yellow orange ..... **11. H. erythrocala**

13. Pileus finely velvety tomentose, at least at the centre (use x10 hand lens); lamellae at first pale cream coloured then more or less yellow; basidiomes always with a slender stipe that is much longer (at least 2–3 times) than the pileus diameter ..... **9. H. cantharellus**
Pileus smooth; lamellae white or bright yellow; stipe not as above..... 14

14. Pileus with yellow, striate margins; lamellae always deeply decurrent and bright yellow ..... **17. H. sp. LC1**
Pileus without yellow, striate margins; lamellae pure white to cream coloured ..... **14. H. lanecovensis**

Key 3 - Pileus Dry, Basidiomes Dull Coloured (Brown, Grey, Black) or White

1. Pileus conical, black or deep grey with adpressed, black fibrils; a pale yellow or clear fluid often weeps from the cut tissues ..... **6. H. astatogala**
Pileus convex or convex and umbilicate, not black or deep grey with adpressed black fibrils; never with pale yellow or clear fluid weeping from cut tissues..... 2

2. Pileus white, usually hygrophanous and striate; stipe white ..... **5. H. virginea**
   Pileus distinctly brown to orange brown; stipe brown 3

3. Stipe 4–5 mm thick, basidiomes robust; pileus dull orange brown and usually covered with a white furfuraceous layer when immature but which is lost as the fungus matures ..... **2. H. austropratensis**
   Stipe 1–3 mm thick, basidiomes delicate; pileus orange brown or grey brown but never covered with a white furfuraceous layer when juvenile 4

4. Stipe with small, adpressed brown fibrils; pileus hemispherical, pallid brown and appearing finely micaceous under a x10 hand lens; lamellae white to greyish white ..... **18. Camarophyllopsis kearneyi**
   Stipe without small, adpressed brown fibrils; pileus convex, orange to orange brown, with fine lilac margins at least in juvenile stages and not appearing finely micaceous under a x10 hand lens; lamellae lilac tinted ..... **7. H. anomala**

Subgen. **Cuphophyllus** Donk, Beih. Nova. Hedwigia **5**: 45 (1962). **Type:** *Agaricus pratensis* Pers.: Fr. [= *Camarophyllus pratensis* (Pers.: Fr.) Kummer.]

Hymenophoral trama irregular; basidiome dull coloured or rarely with bright colours in apricots, pinks or lilac to mauve; lamellae mostly decurrent; cystidia mostly absent; clamps frequent throughout the basidiome.

1. Hygrocybe aurantiopallens (Horak) A. M. Young, Aust. Syst. Bot. **10**: 921 (1997); *Camarophyllus aurantiopallens* Horak, Beih. Nova Hedwigia **43**: 122 (1973). **Type**: New Zealand. Lake Rotoiti, 29 April 1968, *E. Horak* [PDD 27088](holo: PDD).

***Misappl.*:** *Hygrophorus aurantius* Murrill sensu G. Stevenson, Kew Bull. **16(3)**: 382 (1963).

***Illustration*:** Fuhrer & Robinson (1992), p 38; Young & Wood (1997), p922.

Pileus (6–)10–20 mm, convex (occasionally slightly umbonate), expanding to plano-convex; smooth, dry, apricot yellow to light orange (near 4A5), usually darker at the centre, all parts fading with age; red tints completely absent; a little pellucid striate if moist, especially towards the margins; margins usually slightly crenulate, especially when young. Lamellae adnate arcuate to usually subdecurrent; occasionally anastomosing; not especially thick, widely spaced to distant, very frequently connected by veins on the undersurface of the pileus; pallid apricot or pileus tinted, margins concolorous. Stipe 17–44 x 1.5–3.5 mm, cylindrical but often tapers towards the base, smooth, dry, hollow, pale apricot yellow to similar to pileus but paler at the base to near white.

Spores (3.5–)4.0–6.5 x 3.5–4.5(–5.0) µm, mean 5.2 x 4.2 µm, Q: 1.0–1.6, mean Q: 1.2–1.3, mostly subglobose but occasionally sublacrymoid, smooth, hyaline, non-amyloid. Basidia 30–41 (–42.5) x 4.5–7(–8) µm, mean 34 x 6 µm, Q: 4.4–7.5, mean Q: 5.7, 4-spored (occasional 2-spored forms exist), clamped, sometimes with medallion clamps. Cystidia absent. Hymenophoral trama subregular to irregular, composed of hyaline, thin-walled, septate, semi-inflated, at least partially interwoven hyphae 20–90 (–120) x 3–12 (–15) µm, frequently constricted at the septa and often with medallion clamps. Pileipellis a cutis, (often some hyphae partially gelatinise to give the appearance of an ixocutis, but fresh material is not viscid), cuticular hyphae 1–3 µm diameter, clamped, forming a repent layer 20–40 µm deep overlying a subpellicular layer of hyaline, clamped, inflated cells 40–80 x 6–12 µm, cuticular pigment plasmatic and also as granules on the hyphal walls. Stipitipellis a cutis of hyaline, thin-walled, inflated, clamped hyphae 2–4 µm, sometimes overlain with a loose layer of extensively branched, thin-walled, clamped hyphae 3–8 µm; subpellis an array of

inflated, thin-walled, hyaline, clamped, parallel elements 6–11 µm.

***Habitat*:** Gregarious on soil in rainforest.

***Specimens examined*: New South Wales.** Lane Cove Bushland Park, 13 June 1998, *Young* 2107 (BRI); 20 June 1998, *R. & E. Kearney* in *Young* 2171 (DAR).

***Remarks*:** The characteristics of the Lane Cove collections are all extremely similar to those of previously published descriptions of this species and records show that it appears in both June and July. Fuhrer and Robinson (1992) stated that the New Zealand species *Hygrocybe apricosa* Horak (=*Camarophyllus apricosa sensu* Fuhrer & Robinson) occurred in Tasmania and provided a photograph (p38) considered to be this taxon. So far, no Tasmanian or Australian mainland collections of similar material have proven to be this New Zealand taxon which is readily distinguished from *Hygrocybe aurantiopallens* as *Hygrocybe apricosa* has small, ellipsoid spores (3–5 x 2.5–4 µm).

2. Hygrocybe austropratensis A. M. Young, **sp. nov**. Pileus 14–30 mm, convexus denique plano-convexus vel irregularis, aurantiaco-brunneus, pilei juniores cum stratum album furfuraceum. Lamellae decurrentes, aurantiaco-bubalinus pallens. Stipes 20–45 x 47 mm, cremeo-bubalinus pallens, cylindricus, siccus, laevis, stipes juniores cum stratum album furfuraceum. Sporae 6.0–8.3(–9.0) x 5.0–7.3 µm, Q: 1.1–1.4, lato-ellipsoideae usque subglobosae, hyalinae, inamyloideae. Basidia 53–69 x 6–8 µm, (2-)4-spora, fibulata. Cystidia nulla. Trama hymenophoralis irregularis, fibulata. Epicutis pilei cutem formans. Gregaria vel caespitosa in humo sylvestris. **Typus:** New South Wales. Lane Cove Bushland Park. 33°49'S 151°10'E, 7 June 1998, *R. & E. Kearney*. [DAR 73916] (holo: DAR; iso: BRI).

Pileus 14–30 mm, orange to light orange brown (near 4A8), convex or a little irregularly convex expanding to plano-convex and then somewhat irregular to repand, dry; at first coated with a white, furfuraceous layer which is progressively lost as the pileus matures; margins at first involute and may be slightly striate and often with whitish fragments on them similar to the pileal surface. Lamellae decurrent and sometimes apparently forking at the extreme margins on old pilei, no veins noted

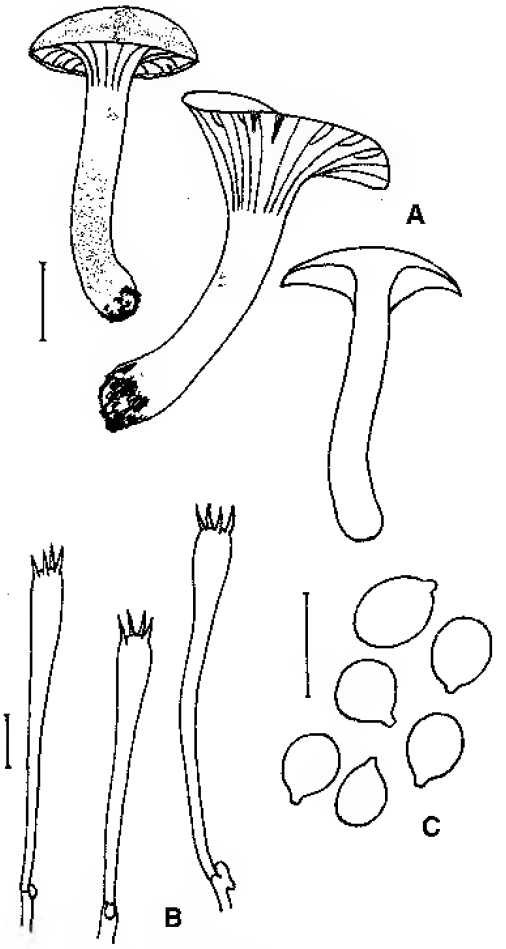

Fig. 1. ***Hygrocybe austropratensis***. A. Habit (bar = 10 mm); B. basidia; C. spores (bar = 10 µm). Holotype DAR 73916.

between lamellae on the pileus undersurface, pale orange buff (4A4) and margins concolorous and even. Stipe 20–45 x 4–7 mm, very pale creamy brown (near 4A3), solid, dry, cylindrical but often bulbous at the base, smooth or usually coated with the white furfuraceous layer which slowly disappears on aging.

Spores 6–8.3(–9) x 5–7.3 µm, mean 7.5 x 6.3 µm, Q: 1.1–1.4, mean Q: 1.2, subglobose to very

broadly ellipsoid, smooth, hyaline. Basidia 53–69 x 6–8 µm, mean 62 x 6.8 µm, Q: 6.6–10.2(–12.6), mean Q: 9.2, 2- or 4-spored, clamped. Cystidia none. Hymenophoral trama irregular composed of hyaline, strongly interwoven, branched, clamped, cylindrical hyphae 2.5–7 µm diameter. Pileipellis a cutis of repent but extensively interwoven hyphae 3–6 µm diameter - in juvenile pilei the whitish layer is represented by an evanescent coating of delicate hyphae similar to the mature pileus' hyphae which disintegrate and disappear. Stipe a cutis of hyaline, thin walled, cylindrical, clamped hyphae 1.5–5 µm diameter. Fig. 1.

***Habitat*:** Gregarious or caespitose on soil amongst eucalypt litter in woodland.

***Remarks*:** This species seems quite close to *Hygrocybe pratensis* (Pers.: Fr.) Murrill. The spores and basidia of *H. austropratensis* are larger than the usual range of European material (5.5–6.5 x 4–5 µm for spores and 40–55 x 5–6 µm for basidia). Other variations include the often bulbous base which is lacking in European material, the much paler stipe and the brown colourations rather than the orange hues of *H. pratensis*. The white furfuraceous coating present abundantly in juvenile Australian material is absent from the European species.

***Etymology*:** a southern hemisphere fungus (Latin, *australis*, south or southern) resembling the European *Hygrocybe pratensis* (Pers.: Fr.) Murrill

3. Hygrocybe cheelii A. M. Young, **nom. nov.**; *Cantharellus lilacinus* Cleland & Cheel, Trans. & Proc. Roy. Soc. S. Australia **43**: 271 (1919); *Camarophyllus lilacinus* (Cleland & Cheel) Horak, New Zealand J. Bot. **28**: 203 (1990); non *Hygrocybe lilacina* (C. Laest. ex P. Karst.) M. Moser, Die Röhrlinge und Blätterpilze (Agaricales) 3 edit., 64 (1967). **Type:** New South Wales. Gladesville. 17 June 1916. (holo: AD, n.v.).

***Illustration*:** Willis (1963), plate 9, 1 as *Cantharellus lilacinus*.

Pileus 15–25 mm, bright pinkish mauve or lilac (15B5), convex, dry, smooth but finely velvety under a x10 lens, margins at first involute, sometimes a little crenulate or slightly plicate when immature, always with a fine white zone about 1 mm wide at the pileus margins. Flesh

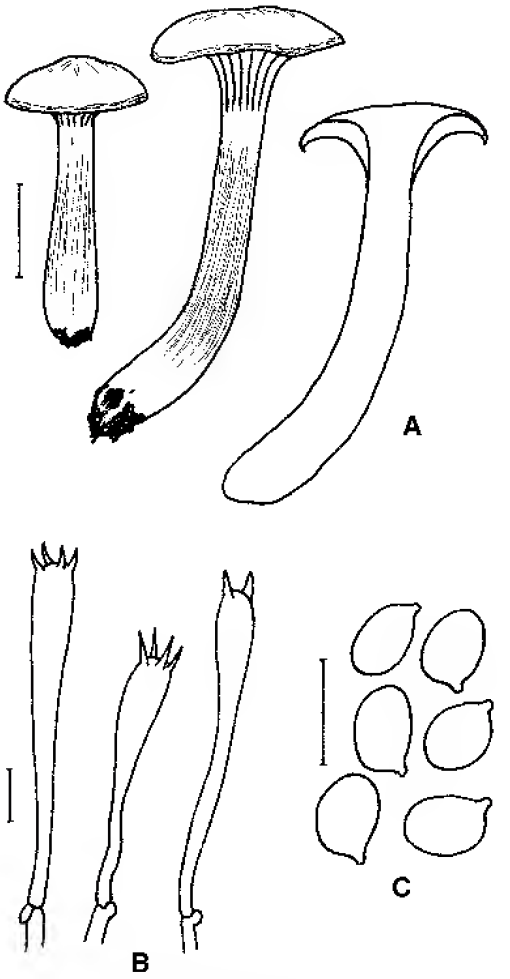

Fig. 2. ***Hygrocybe cheelii***. A. Habit (bar = 10 mm); B. basidia; C. spores (bar = 10 µm). Y2118.

thick, white and with lilac tints in the pileus, may discolour slightly to yellowish brown in the tissues at the stipe base. Lamellae deeply decurrent sometimes arcuate, mauve lilac (15B3–15C3) and often with paler margins, distant, thick, sometimes forking especially towards the pileus margins. Stipe 30–50 x 7–9(–12) mm, pinkish mauve or lilac and concolorous with the pileus but yellow (3A3)

towards the stipe base, dry, fibrillose, solid, cylindrical superiorly but usually inflated towards the base.

Spores 6.7–8.7 x 4.7–6.3 µm, mean 7.8 x 5.5 µm, Q: 1.1–1.9, mean Q: 1.4, subglobose to ellipsoid, hyaline, smooth. Basidia 47–70 x (6–)7–9 µm, mean 59 x 7.7 µm, Q: 6.3–10.0, mean Q: 7.7, 4-spored but with some 2-spored basidia often scattered amongst the rest, clamped. Cystidia absent. Hymenophoral trama irregular and composed of interwoven, hyaline, cylindrical or sometimes a little inflated, branched hyphae 2–6 µm diameter, clamps abundant. Pileipellis a loose cutis (often approaching a trichoderm) of cylindrical, non-inflated, interwoven, branched hyphae 2.5–4.0 µm diameter often with short sections of hyphae projecting above the surface of the remainder and then with rounded, obtuse apices, pigment granules often present, clamps abundant. Stipitipellis a loose cutis of parallel and interwoven hyphae 1.5–5.0 µm diameter, clamps abundant, pigment granules usually visible on outermost hyphae. Fig. 2.

***Habitat*:** Gregarious to caespitose on soil amongst leaf litter in wet or dry sclerophyll forest.

***Specimen examined*: New South Wales**. Sheldon Forest Park. 34°44' 151°07'E., 14 June 1998, *F. Taeker* in *Young* 2118 (BRI).

***Remarks*:** This taxon regularly appears in the Lane Cove Bushland Park and cannot be confused with any other species as no other Australian taxon has its intense and almost artificial colouration. Confirmatory photographic material is held for Lane Cove Park but no herbarium material. The description has been taken from typical material collected at a Sydney site approximately 10 kilometres distance. Originally placed in genus *Cantharellus* by Cleland and Cheel, there is no doubt that it is a valid member of the Hygrophoraceae as the lamellae are characteristic of the Agaricales not the pseudo-lamellae developed from hymenial folds that characterise the Cantharellaceae. The general morphology and the very irregular hymenophoral trama place this taxon in subgenus *Cuphophyllus*. This particular collection is of interest as amongst the normal spores were a small number of larger, smooth, ellipsoid spores measuring about 11 x 8 µm. These larger spores do not appear to be contaminants and they may be derived from the occasional 2-spored basidia.

***Etymology*:** after Edwin Cheel, botanical assistant at the Botanic Gardens, Sydney, New South Wales.

4. Hygrocybe reesiae A. M. Young, Aust. Syst. Bot. **10**: 923 (1997). **Type:** New South Wales. Lane Cove Bushland Park, 17 June 1990, *R. Kearney & B. Rees* [UNSW 90/205](holo: UNSW).

***Illustration*:** Young & Wood (1997), p924.

Pileus 10–20 mm, convex but depressed at the centre to almost umbilicate when mature, smooth, dry, margins even and not splitting, pale lilac to lilac grey (near 16B3) but fading to buff when old (4B4–4A3). Lamellae deeply decurrent, distant, thick, 1 or 2 sets lamellulae, deep lilac to near violet (16B6), margins concolorous. Stipe 16–30 x 3–4 mm, dry, smooth, cylindrical, pallid lilac (16A3) but darker superiorly becoming buff (4B4 4A3), hollow.

Spores (6–)6.5–9.0(–9.7) x 4.5–6.8 µm, mean 7.7 x 5.8 µm, Q: 1.1–1.5, mean Q: 1.3–1.4, very broadly elliptical to almost subglobose, apiculus prominent, smooth, hyaline, non-amyloid, thin-walled. Basidia 50–60 x (5.5–) 6.5 –9.5 µm, mean 56 x 7.7 µm, Q: 5.9–9.2, mean Q: 7.4, 4-spored, clamped and often approaching medallion clamps or medallion clamps present. Cystidia absent. Hymenophoral trama subregular to interwoven, composed of hyaline, thin-walled, occasionally branching elements, 20–60 x 3–7 (–10) µm, only slightly constricted at the septa, but with abundant clamps some with medallion form, usually more irregular towards the margins. Pileipellis a cutis composed of an up to 10 µm thick layer of very narrow, hyaline, clamped hyphae (some medallion clamps), 2–3 µm diameter with the hyphal ends rounded, overlying a subparallel to interwoven subpellis of more inflated hyphae 2–9 µm diameter, frequently septate and clamped at all septa, frequently branching. Stipitipellis a cutis of hyaline, thin-walled,

clamped hyphae, 2–4 µm diameter, medallion clamps present.

***Habitat*:** Gregarious on soil in woodland; often found in forests, frequently amongst moss.

***Specimens examined*: New South Wales.** Lane Cove Bushland Park, 33°49'S 151°10'E. 7 June 1998, *R. & E. Kearney* in *Young* 2074 (BRI); in *Young* 2079 (DAR).

***Remarks*:** *Hygrocybe reesiae* is very widespread in the Sydney and Blue Mountains region of New South Wales and also occurs commonly in Tasmania. Its lilac colouration is generally quite distinct when the basidiomes contain their normal moisture, however the colours tend to pale to a lilac tinted buff when the basidiome surfaces dry out. The species often occurs in small troops.

5. Hygrocybe virginea (Wulfen: Fr.) Orton & Watling, Notes R. B. G. Edinb. **29**: 132 (1969); *Agaricus virgineus* Wulfen, in Jacq., Misc. austr. **2**: 104 (1781); *A. virgineus* Wulfen: Fr., Syst. mycol. **1**: 100 (1821); *Hygrophorus virgineus* (Wulfen: Fr.) Fr., Epicr.: 327 (1838); *Camarophyllus virgineus* (Wulfen: Fr.) Kummer, Führ. Pilzk.: 117 (1871); **Type:** none designated.

Agaricus niveus Scop., Fl. carn., Ed.2, **2**: 430 (1772); *A. virgineus*, var. *niveus* (Scop.) Fr., Syst. mycol. **1**: 100 (1821); *Hygrophorus niveus* (Scop.) Fr., Epicr.: 327 (1838); *Camarophyllus niveus* (Scop.) Wunsche, Pilze: 115 (1877). **Type:** none designated.

***Illustrations*:** Cleland (1934) Plate III as *Hygrophorus niveus* (Scop.) Fr.; Boertmann (1995), 49; Young & Wood (1997), p929.

Pileus 19 35 mm, expanded convex becoming more or less plane and then usually umbilicate, smooth, dry, pure white becoming dull cream-coloured when old and often with cream-coloured tints at the very centre, when young appearing water soaked and pellucid striate for at least half the diameter of the pileus. Lamellae usually strongly decurrent, thick, distant, one set of lamellulae present, pure white or slightly tinted cream-colour with age, margins concolorous, some intervening is present between the lamellae when old. Stipe 30–50 x 2–5 mm, pure white to slightly tinted cream-colour with age, more or less cylindrical near the lamellae but tapering towards the base, dry, smooth.

Spores (6.5–)7.0–11.0 x 4.0–6.6 µm, mean 7.5 x 5 µm, Q: 1.3–2.0, mean Q: 1.6, smooth, hyaline, non-amyloid, oblong to ellipsoid. Basidia 35–68(–80) x 5–7 (8.5) µm, mean 51 x 7, Q: 5.3–10, mean Q: 7.2, (2-)4-spored, clamped. Cystidia absent. Hymenophoral trama irregular, interwoven, composed of a mixture of hyaline, thin-walled, normal and inflated hyphae 36–110 x 3–20 µm, clamps present. Pileipellis a cutis of repent hyphae, 1–2 µm diameter, clamped, thin-walled, hyaline and slightly gelatinised. Stipitipellis a cutis of hyaline, thin-walled, clamped hyphae 2–4 µm.

***Habitat*:** gregarious on soil amongst litter or moss in rainforest or open woodland.

***Specimens examined*: New South Wales.** Lane Cove Bushland Park, 33°49'S 151°10'E. 13 June 1998, *A. M. Young*, (*Young* 2104 in BRI); 20 June 1998, *R. & E. Kearney*, (*Young* 2174 in DAR).

***Remarks*:** This species occurs in troops in the moister eucalypt litter areas close to the central core of the rainforest. The pure white, more or less dry basidiomes with their deeply decurrent lamellae make them very easy to distinguish. The only Australian taxon with which *H. virginea* may be confused is *H. rodwayi* (Massee) A. M. Young which is readily separated by its marked cream colouration and small, subglobose spores (5.0–7.0 x 4.5–5.5 µm). Cleland (1934) recorded *Hygrophorus niveus* (Scop.) Fr. from the Blue Mountains (NSW), however material of his collection has not been located. Other Cleland collections of *H. niveus* have proven to be *H. rodwayi* which seems to be the most common of the two white taxa. The photograph supposedly of *Camarophyllus niveus* by Fuhrer and Robinson (1992) p39 is incorrect and appears to be an excellent photograph of the white form of *Hygrophorus involutus* G. Stevenson. (The nomenclatural priority of *Hygrocybe virginea* over *Hygrocybe nivea* is covered by Arnolds 1986, page 157.)

Subgen. **Hygrocybe. Type:** *Hygrocybe conica* (Schaeff.: Fr.) Kummer.

Hymenophoral trama strictly regular, composed of very long (500–3000 µm), tubular, aseptate elements with tapered ends; basidiome frequently vividly coloured (red, orange, yellow); pileus often conical; lamellae free, adnexed or narrowly adnate; cystidia sometimes present; clamps generally present throughout the basidiome.

6. Hygrocybe astatogala (Heim) Heinemann; *Bertrandia astatogala* (Heim) Heim, Rev. Mycol. **31**: 155 (1966); *Hygrocybe astatogala* (Heim) Heinemann, Bull. Jard. Bot. État **33**: 436 (1963). **Type:** Madagascar. (holo: P. n.v.)

***Illustrations*:** Fuhrer & Robinson (1992), p38; Young & Wood (1997), p 933.

Pileus 13–30(–60) mm, at first elongated ellipsoid with margins adpressed to the stem, then rapidly expanding to conical but with the margins remaining more or less incurved, finally broadly conical with obtuse apex; immature colour very variable: red (10B8), orange (5A8) or yellow (3A7) (or mixtures of these colours and sometimes with greenish tints), often overlain with sooty black, eventually more or less black with only a few tints remaining of the previous colours; surface dry, smooth, and covered with radially adpressed, black fibrils; margins even to ragged and often paler than the pileal surface; frequently splitting radially. Pileal flesh very thin, similar to or slightly darker than the pileal cuticle colour directly above; stem flesh usually yellow (2A6). Lamellae adnate-ascending to more or less free, yellow (3A6) to orange (5A8) especially near the margins but darker near the pileus tissues, thick, usually well-spaced, waxy in appearance; margins entire, concolorous. Stipe (40–)60–85 x 3–4 mm, dry, cylindrical but often tapering apically, may be slightly fissured longitudinally and a little twisted, hollow, very pale yellow (3A3) to orange (4A5), may have red tints, white at the base; more or less covered with black fibrils. Odour none, taste mild. All tissues exude a clear to yellow tinted aqueous fluid when cut and rapidly turn black on exposure to air.

Spores 7.5–10.0 x 6.0–8.5 µm, mean 8.7 x 6.8 µm, Q: 1.0–1.6, mean asQ: 1.3, very broadly ovoid or ellipsoid but mostly subglobose, with prominent apiculus, hyaline, thin-walled, non-amyloid, often with dark, contents. Basidia 33–42 x 7–11 µm, mean 37 x 9 µm, Q: 3.1–4.7, mean Q: 4.0, (1-,2-,3-) 4-spored, clamped. Cheilocystidia 46–130 x 15–35 µm, inflated, hyaline, thin-walled, globose, pyriform or clavate, clamped, conspicuous and densely crowded along the lamellae margins. Pleurocystidia absent. Hymenophoral trama regular, composed of thin-walled, tubular, parallel, aseptate hyphae 2–22 x 1000–2000 (–3000) µm; the hyphal ends tapering to obtuse or rounded apices, often sinuous, and frequently with dark contents; lactifers (6–14 µm) intermixed. Pileipellis a cutis of cylindrical, thin-walled, clamped hyphae 5–18(–24) µm diameter with lactiferous hyphae 6–14 µm intermixed; fibrillose hyphae present with dark contents 4–12 µm diameter. Caulocystidia absent. Stipitipellis a fibrillose cutis of parallel, thin-walled, clamped hyphae, 3–8 µm often with dark plasmatic contents.

***Habitat*:** Solitary or in small groups on soil amongst forest leaf litter; often in very sheltered and moist locations.

***Specimens examined*: New South Wales.** Bola Creek-Royal NP, 15 June 1998, *F. Taeker*, (*Young* 2119 in DAR); Mt. Wilson, 17 June 1998, *A. M. Young*, (*Young* 2143 in BRI).

***Remarks*:** Photographs from the Gore Creek site have been conclusively identified as this taxon which is reported to appear regularly each season. No material is held. The red then blackening, conical pileus with numerous adpressed black fibrils is unmistakable, and it is only a matter of time before the taxon is re-collected. The species occurs widely in the Sydney and Blue Mountains district. Cleland collections of this species were misidentified as *Hygrophorus conica* Fr. but an unmistakeable watercolour of this taxon was made by Miss Clarke from a May 1915 Cleland collection from Neutral Bay. The known Australian range extends from south eastern Queensland to Tasmania.

Subgen. **Pseudohygrocybe** M. Bon., Doc. Mycol. **24**: 42 (1976). **Type:** *Hygrocybe coccinea* (Schaeff.: Fr.) Kummer.

Hymenophoral trama regular, subregular to slightly irregular, composed of short, cylindrical to inflated elements 20–300 µm long (rarely up to 700 µm); basidiome variously coloured often brightly (red, orange, yellow, green, lilac); pileus conical, convex or umbilicate; lamellae narrowly adnate to decurrent; cystidia sometimes present as cheilocystidia, rarely as pseudo-pleurocystidia; clamps generally present throughout the basidiome.

7. Hygrocybe anomala A. M. Young, Aust. Syst. Bot. **10**: 919 (1997). **Type:** New South Wales. Blackheath. 23 June 1983, *A. E. Wood*, UNSW 83/991 (holo: UNSW).

1. Pileus viscid; without lilac tints on pileus or lamellae ..... var. **anomala**
   Pileus dry; lilac tints present on either or both pileus and lamellae ..... var. **ianthinomarginata**

Hygrocybe anomala var. **anomala**

H. anomala var. *anomala* has not been recorded from the Lane Cove Bushland Park.

Hygrocybe anomala var. **ianthinomarginata**, A. M. Young **var. nov**. Differt a *H. anomala* pilei marginata lilacina vel ianthina, lamellae lilacinae, epicute pilei et stipes cutem formans nunquam ixocutem. **Typus:** New South Wales. Lane Cove Bushland Park. 33°49'S 151°10'E. 13 June 1998, *R. & E. Kearney & A. M. Young*. [DAR 73918] (holo: DAR).

Pileus 8–18 mm, convex to expanded convex or sometimes slightly umbonate, orange brown (5B4–4A3) or buff (4A3–4B4) and almost always with a darker, reddish centre 'dot' (7A8) especially as the pileus matures, smooth, dry, finely scaly under a x10 lens, striate, margins strongly crenulate and tinted lavender/lilac/violet (12A2–14A2). Lamellae decurrent, pale lilac (12A2–14A2) sometimes deeper lavender/violet 16A3–16A4) and occasionally with pinkish tints, margins even and concolorous, thick, distant, veins present on the pileus undersurface. Stipe 20–40 x 1.5–2.5 mm, red, reddish orange or orange (5A7, 7A8–8A8), smooth to finely fibrillose, dry, hollow, cylindrical.

Spores (6.0–)6.7–8.7(–10.0) x 4.0–5.7(–6.0) µm, mean 7.7 x 4.5 µm, Q: 1.4–2.2, mean Q: 1.7, smooth, hyaline, ovoid or ellipsoid to cylindrical and at least some cylindrical spores medially constricted. Spinose spores scattered frequently, occasionally or sometimes infrequently amongst the normal spores and having similar overall dimensions and Q's to those of normal spores, outline frequently polygonal with the spines emerging from the angles of the polygon, spines conical, apices obtuse and 0.5–2.5 µm in height. Basidia 33–57 x 6–8 µm, mean 44 x 7 µm, Q: 5.0–8.0, mean Q: 6.1, 4-spored, clamped. Cystidia absent. Hymenophoral trama regular to subregular, in the upper $^2/_3$rds of the lamella composed of parallel chains of cylindrical, hyaline, thin walled elements 10–45 x 4–11 µm but then becoming irregular and the lower $^1/_3$ of the lamellae near the margins composed of subglobose to polyhedral, hyaline, thin walled elements 4–12 µm diameter, clamps present but sometimes rare. Pileipellis a cutis composed of repent, hyaline, thin walled cylindrical hyphae 2–5 µm diameter, clamps present. Stipitipellis a cutis of repent, thin walled, hyaline, cylindrical septate hyphae 1–4 µm diameter, clamps occasional. Fig. 3.

***Habitat*:** Gregarious or caespitose on soil amongst litter, occasionally may occur in small troops.

***Remarks*:** *Hygrocybe anomala* was described from a collection which represented one of the basidiome variations produced by this mutable taxon. Further collections indicate that the viscid characters of stipe and pileus may or may not be present. The Lane Cove Bushland Park collections do not appear to have any viscidity of either pileus or stipe, however the viscid nature of both structures is clearly recorded in photographs for both the holotype of var. *anomala* and the accompanying

collection of UNSW 83/988A. In addition, re-examination of the holotype (UNSW 83/991) of var. *anomala*, with emphasis on the juvenile basidiomes, has clearly demonstrated the agglutinated/gelatinised nature of the surface hyphae of the pileus together with numbers of spores that adhere very firmly to the surface hyphae even after gentle warmth is applied to mounted preparations of the pileipellis. There is now no doubt that var. *anomala* has an ixocutis even though it may apparently be absent in mature basidiomes due to local climatic conditions. The new variety does not appear ever to produce an ixocutis on either pileus or stipe.

Pinkish tints only were recorded for the lamellae of var. *anomala* and neither of the Blackheath collections show a lilac/violet margin to the pileus. Collections of var. *ianthinomarginata* made from various locations in the Sydney and Blue Mountains region during the 1998 collecting season show that the lilac tints of the lamellae are generally very distinctive when the basidiomes are young but then may fade a little as the basidiome matures.

The colours of the pileus and stipe in both varieties are inconstant. Depending upon the collection, the pileus varies from warm orange to pallid yellow orange while the central, reddish brown 'dot' may or may not be prominent. The stipe colour is also variable and may range from pallid orange yellow to strongly orange red or almost pure red.

Re-examination of the var. *anomala* holotype collection demonstrated conclusively that the material has a sub-regular tramal structure with interwoven hyphae at higher magnification (x400), however at lower magnification (x100) the trama appears more or less regular. The trama's structure also varies depending upon where it is examined: near the lamellae margins, it is usually more irregular, at the midpoint between margin and pileus it is usually sub-regular, while near the pileus, it is generally regular. There seems little doubt that *H. anomala* was incorrectly placed in subgenus

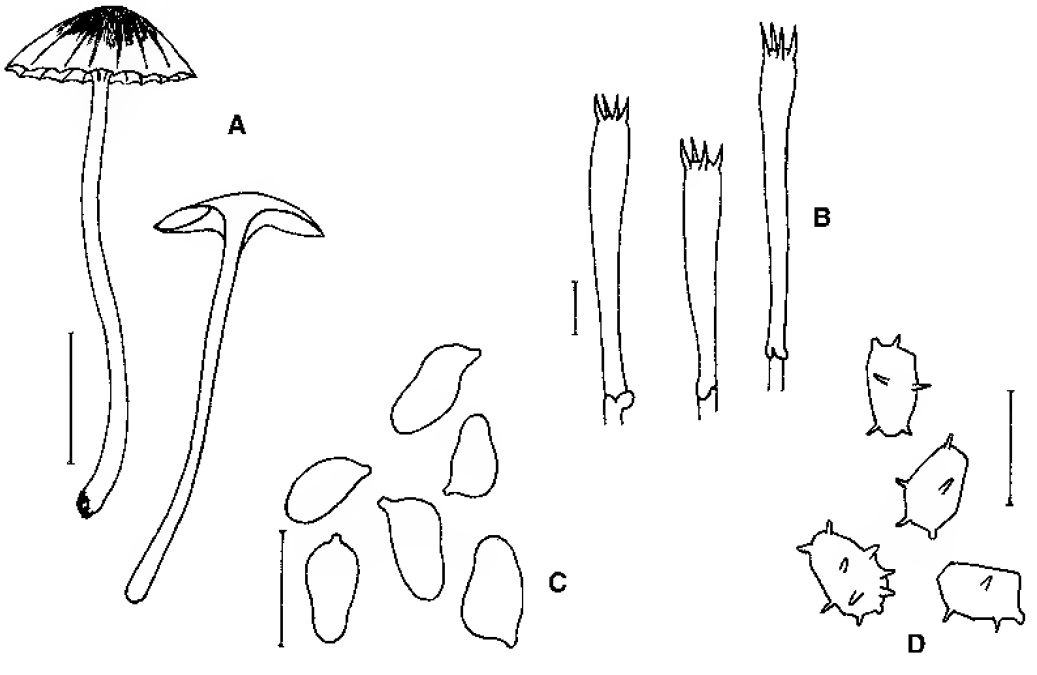

Fig. 3. ***Hygrocybe anomala*** var. ***ianthinomarginata***. A. Habit (bar = 10 mm); B. basidia; C. normal spores; D. spinose spores (bar = 10 µm). Holotype DAR 73918.

Cuphophyllus in the previous paper of Young and Wood (1997) and should be transferred to sub-genus *Pseudohygrocybe*.

Hygrocybe anomala is very wide spread with collections of both varieties also known from Tasmania. It seems to be unique amongst the Australian species with its spinose spores scattered amongst the normal spores. Examination of a number of collections has shown that in any one collection, the number of spinose spores present may vary from very common to sparse. Re-examination of the holotype of var. *anomala* and the accompanying Blackheath material (UNSW 83/988A) has revealed abundant 'polygonal', spinose spores in both collections. It is difficult to account for their omission from the original description, however no spinose spores were known to occur in any Australian species of this genus at that time. Even if the spinose spores had been sighted, they would have been disregarded as contaminants. The spores are sometimes difficult to find and can be overlooked, however they have been found to be present in all collections believed to be this taxon, including the material obtained from further field work in the Blue Mountains of New South Wales during 1998. Usually, the 'polygonal' outline of the spores (typically with the spines emerging from the corners) is quite distinctive under the microscope but these spinose spores also appear to have a slightly different refractive index to the normal spores and they frequently take up the mounting stain more intensely than the normal spores. Experience has shown that they are best searched for in areas of a lamella squash that have not been thoroughly spread apart because they seem to adhere more strongly to the hymenial layer. They are shed from the basidia like normal spores as they can be found on the stipe surface and very occasionally on the pileus surface, obviously been distributed by wind currents.

***Etymology*:** Greek, *ianthinus*, violet or lilac, referring to the lilac margins of the pileus.

8. Hygrocybe aurantipes A. M. Young, Aust. Syst. Bot. **10**, 954 (1997). **Type:** New South Wales. Lane Cove Bushland Park, 33°49'S 151°10'E, 17 June 1990, *R. Kearney & B. Rees* [UNSW 90/208](holo: UNSW).

***Illustration*:** Young & Wood (1997), p955.

Pileus 20–40 mm, conical becoming expanded conical and finally more or less plane sometimes with the margins reflexed, smooth, dry; not radially fibrillose; at first dark olivaceous brown (4F8–5F8) then rapidly with greenish yellow tints as the pileus expands and often with orange tints when old; margins not splitting, a little pellucid striate and usually lighter in colour when young. Lamellae narrowly adnate to adnate with slight decurrent tooth, distant, thick, extensively connected by veins across the pileus' undersurface and these may reach up to halfway across the lamellae face, 1 set lamellulae, yellowish cream to buff-cream or yellowish orange (3A4–3B4), margins concolorous. Stipe 30–60 x 3.5–7.0 mm, cylindrical but often flattened, the stipe base may be either inflated or slightly tapered, smooth, dry, pale yellow-orange (4A6, 5A6–6A6) but sometimes with apricot pink tints, usually more pallid superiorly, base concolorous but may be white or more yellowish, hollow.

Spores (7.0–)7.3–10.0 x (4.3–)4.5–6.0 µm, mean 8.3 x 5.1 µm, Q: 1.4–1.9, mean Q: 1.6, broadly oblong to ellipsoid, occasionally a little constricted, smooth, hyaline, non-amyloid. Basidia (46–)51–71 x 7–10 µm, mean 56 x 8.5 µm, Q: 5.0–9.0, mean Q: 7.0, (2-)4-spored, clamped. Cystidia absent. Hymenophoral trama regular, composed of short, inflated, often tapering elements 25–120(–150) x 4–30 µm, interspersed with occasional branching hyphae 4–10 µm diameter, clamps present and sometimes approaching medallion clamps, lactifers present as highly refractive, tortuous, hyaline, thin-walled hyphae 3–7 µm. Pileipellis a cutis composed of hyaline, thin-walled, clamped hyphae 1–3 µm diameter overlying a subpellis of inflated, clamped, fusiform to cylindrical elements 30–150 x 4–20(–30) µm, lactifers present in the subpellicular layer as highly refractive, thin-walled, hyphae 3–7 µm and with slightly brownish contents. Stipitipellis a cutis of clamped, hyaline, thin-walled hyphae 1–3 µm diameter, overlying cylindrical, septate, rarely clamped hyphae up to 8 µm diameter.

***Habitat and distribution*:** Gregarious on soil in woodland or rainforest; abundant in the Blue Mountains, New South Wales.

***Specimens examined*: New South Wales**. Mt. Wilson, 17 June 1998, *A. M. Young* (*Young* 2145 in DAR); Lane Cove Bushland Park, 33°49'S 151°10'E 12 August 1998, *R. & E. Kearney* (*Young* 2157 in BRI).

***Remarks*:** The species is quite distinctive with its olive brown pilei and very contrasting bright yellow-orange stipe and lamellae.

9. Hygrocybe cantharellus (Schwein.) Murrill, (as *Hydrocybe*), Mycologia **3**: 196 (1911); *Agaricus cantharellus* Schwein., Schr. Nat. Ges. Leipzig **1**: 88 (1822); *Hygrophorus cantharellus* (Schwein.) Fr., Epicr.: 329 (1838). **Type:** none designated.

***Illustrations*:** Boertmann, D (1995): 111; Young & Wood (1997), p962.

Pileus (9–)10–22 mm, hemispherical to convex or plano-convex, occasionally slightly depressed at the centre, margins almost always distinctly crenulate, surface dry and smooth except for the centre where the pileus is usually slightly to distinctly scurfy or finely fibrillose, dull to brilliant red (7B5/7C6) fading to lighter shades of red or orange (5B5) with age and often more or less yellowish at the margins, may appear very slightly striate when moist. Lamellae usually very distant, thick, off-white or pale cream coloured (2A2) becoming yellow (3A5), margins concolorous and even, very broadly adnate with decurrent tooth or arcuate or more commonly deeply decurrent. Stipe 20–45 x 1–2.5 mm, cylindrical or occasionally slightly flattened, smooth, dry, brilliant red (10A8) often yellowish at the extreme base.

Spores (7.0–) 8.0–11.0(–11.5) x (4.0–)5.0–7.0(–9.0) µm, mean 9.3 x 6.3 µm, Q (1.2–)1.4–2.1, mean Q: 1.4, ellipsoid, oblong or occasionally phaseoliform, smooth, hyaline, non-amyloid. Basidia 36–61 x 7–11 µm, mean 45 x 9 µm, Q: 3.3–8.5, mean Q: 5.2, mostly 4-spored but occasionally 2-spored, clamped and narrowly clavate in some collections but broadly clavate in others. Cystidia absent. Hymenophoral trama regular, composed of clamped, parallel to slightly interwoven hyphae which are often inflated and constricted at the septa, 24–90 x 3–20 µm. Pileipellis a cutis of clamped hyphae (4–)6–12 µm, constricted at most septa with a trichoderm at the centre. Stipitipellis a cutis of thin-walled, hyaline, clamped hyphae 1–3 µm overlying similar but broader hyphae 5–12 µm.

***Habitat and distribution*:** Gregarious and common on soil amongst moss and litter in forests, especially beside creek banks in eastern Australia.

***Specimen examined*: New South Wales.** Lane Cove Bushland Park, 33°49'S 151°10'E. 12 September 1998, *R. & E. Kearney* (*Young* 2194 in BRI).

***Remarks*:** The distinguishing characteristics of this taxon are the dry, red pileus and stipe, the finely velvety surface of the pileus (at least at its centre) and the yellowish, decurrent lamellae. A basidiome always has an 'elongated, tent-peg' shape with narrow diameter pileus and long stipe.

10. Hygrocybe chromolimonea (G. Stevenson) May & Wood, Mycotaxon **54**: 147–150 (1995); *Hygrophorus chromolimoneus* G. Stevenson, Kew Bull. **16**: 383 (1962), *Gliophorus chromolimoneus* (G. Stevenson) Horak, Beih. Nova Hedwigia **43**: 167 (1973). **Type:** New Zealand. Lake Rotoiti, 16 May 1956, *E. B. Kidson*, [*Stevenson* 1088 in K](holo: K).

***Illustrations*:** Fuhrer and Robinson (1992): 41; Young & Wood (1997), p964.

Pileus 7–20 mm, convex with centre depressed and becoming plane but remaining somewhat umbilicate, smooth, viscid to glutinous, bright chrome yellow (all shades from 1A8–3A8) fading with age, a little translucent striate; margins crenulate. Lamellae arcuate or decurrent, thin, spaced, 1 set of lamellulae, light chrome yellow becoming pale lemon yellow (1A4–2A4), margins usually slightly greyish due to the presence of a glutinous thread. Stipe 30–35 x 2–3 mm, equal or tapering downwards, smooth, viscid to glutinous, chrome yellow (similar to pileus) becoming paler with age.

Spores (6.3–)7.0–9.0(–11.0) x 4.0–6.0(–6.7) µm, mean 7.7 x 4.8 µm, Q: (1.2–)1.4–1.8, mean Q: 1.6, oblong to elliptical, smooth, hyaline, thin-walled, non-amyloid. Basidia (31–)36–46

(–50) x (6–)6.5–9(–10.5) µm, mean 39 x 7.5 µm, Q: 4.0–6.5, mean Q: 5.5, 4-spored, clamped. Cheilocystidia gelatinised, embedded in a thread of clear gluten, abundant and occasionally interspersed with basidia, hyaline, thin-walled, clavate and often sinuous, clamped at their bases, 30–50 x 3–8 µm. Pleurocystidia absent. Hymenophoral trama regular and composed of parallel and inflated elements, hyaline, thin-walled, varying from more or less cylindrical to sub-globular, frequently clamped, 30–90 x 12–55 µm. Pileipellis an ixotrichoderm of septate hyphae, 3–6 µm diameter, clamped, hyphae usually aerial but may be firmly adpressed to the pileus on maturity, strongly gelatinised and difficult to discern; the ixotrichoderm overlying a subpellicle of hyaline, thin-walled, clamped, inflated more or less cylindrical cells, 50–200 x 16–25 µm. Stipitipellis an ixocutis of clamped, hyaline, cylindrical hyphae 2–3 µm, subpellicle of parallel, hyaline, clamped, thin-walled hyphae 5–12 µm.

***Habitat and distribution*:** Gregarious on soil in forest, but apparently rare at the Lane Cove site. The species also occurs in Tasmania.

***Specimens examined*: New South Wales.** Lane Cove Bushland Park, 33°49'S 151°10'E. 13 June 1998, *A. M. Young* (*Young* 2113 in DAR); 12 July 1998, *R. & E. Kearney* (*Young* 2160 in BRI).

***Remarks*:** The viscid and wholly bright yellow basidiomes are very distinctive. The greyish, glutinous edge on each lamella is easily seen with a x10 hand lens.

11. Hygrocybe erythrocala A. M. Young, Aust. Syst. Bot. **10**: 970 (1997). **Type:** New South Wales. Mt. Wilson, 27 March 1993, *A. E. Wood* [UNSW 93/7](holo: UNSW).

***Illustration*:** Young & Wood (1997), p971.

Pileus 14–35 mm, conical becoming broadly obtuse conical or sub-umbonate, at first viscid but usually very quickly drying and then appearing shiny as if varnished (see notes below), smooth, light crimson (10A8) to orange (near 6A8) but paling with age and margins more yellow-orange (5A7), pellucid striate from the margins up to one third of the pileus diameter. Lamellae broadly adnate with a very small decurrent tooth, thick, spaced, cream then pinkish cream or with orange tints (4A5–4A4), margins concolorous and even. Stipe 20–30 x 2–3.5 mm, equal, firm, smooth, dry or a little sticky, yellowish or yellowish orange (4A5–4A4) inferiorly and flushed pink (6A4) near the lamellae.

Spores (6.3–)6.7–9.0(–9.5) x (3.3–)3.7–4.7(–5.0) µm, mean 7.3 x 4.1 µm, Q: 1.4–2.0 (–2.5), mean Q: 1.8, oblong to ellipsoid or sub-lacrymoid, sometimes medially constricted, hyaline, thin-walled, non-amyloid. Basidia (35–)38–46(–50) x 5–8(–10) µm, mean 42 x 6 µm, Q: (4.1–)5.9–8.2, mean Q: 6.9, 4-spored, rarely 2-spored, clamped. Cystidia absent. Hymenophoral trama regular, composed of thin-walled, hyaline elements, some of which are inflated and sub-fusoid while others are more or less cylindrical 22–90(–100) x 6–18 µm, clamps present and may be medallion form especially with the inflated sub-fusiform elements, lactifers present as highly refractive, thin-walled, hyaline, tortuous hyphae 2–5 µm. Pileipellis an ixocutis of repent, clamped, hyaline hyphae 3–12 µm but with erect elements up to 60 µm high sometimes with inflated terminal elements, lactifers present as hyaline, thin-walled, highly refractive hyphae 4–6 µm, overlying a subpellicular trama of more or less elliptical to sub-fusoid, hyaline, thin-walled, clamped cells 20–60 x 10–40 µm. Stipitipellis a cutis to ixocutis of repent, hyaline, clamped, thin-walled hyphae 2–6 µm.

***Habitat and distribution*:** Gregarious on soil in rainforest. The species is widespread in the Sydney and Blue Mountains district of New South Wales.

***Specimens examined*: New South Wales.** Lane Cove Bushland Park, 33°49'S 151°10'E. 7 June 1998, *R. & E. Kearney* (*Young* 2072 in BRI); 13 June 1998, *A. M. Young* (*Young* 2108 in DAR).

***Remarks*:** The viscidity of *H. erythrocala* is very variable. Young basidiomes are distinctly viscid on the pileus and to a much lesser degree (or even dry) on the stipe in humid conditions, but this character is quickly lost during dry weather or even as the basidiomes mature. When dry, the pilei become opaque and the striations disappear. The colour of the pileus also varies: some collections are bright red but others are orange.

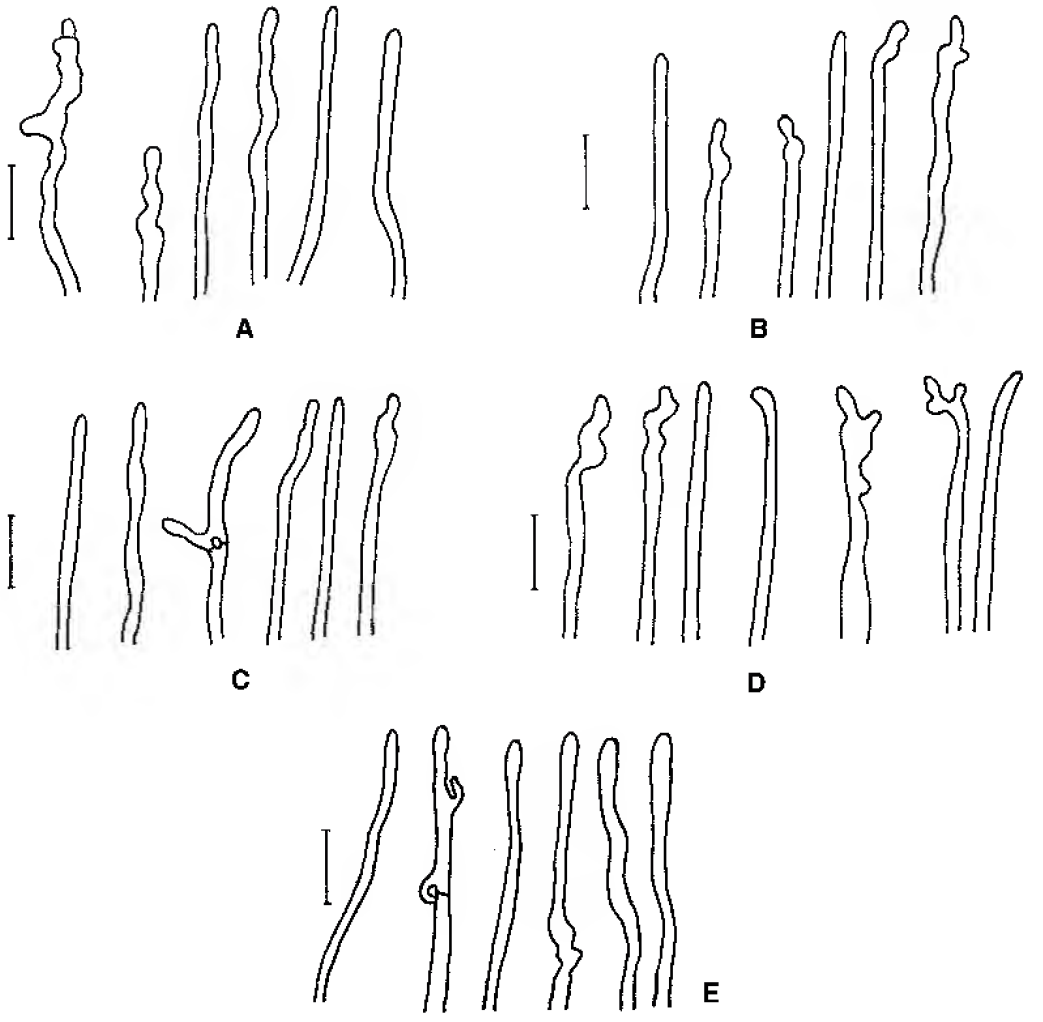

Fig. 4. ***Hygrocybe graminicolor***. Typical cheilocystidial endings from:
A. *Gliophorus graminicolor* holotype PDD 27096 B. *Gliophorus pallida* holotype PDD 27090; C. Typical Australian *Hygrocybe graminicolor* Y2150, Y2170; D. Typical Australian *Hygrocybe pallida* Y2070, Y2186; E. *Hygrocybe batesii* holotype UNSW 84/522 (bars = 10 µm).

12. Hygrocybe graminicolor (Horak) May & Wood, Mycotaxon **54**: 147–150 (1995); *Gliophorus graminicolor* Horak, Beih. Nova Hedwigia **43**: 176 (1973). **Type:** New Zealand. Ngahere, 21 March 1968, *E. Horak*, [PDD 27096](holo: PDD).

Hygrocybe batesii A. M. Young, Aust. Syst. Bot. **10**: 956 (1997). **Type:** Australia. New South Wales. Monga State Forest, 16 May 1984, *A. E. Wood & N. B. Gartrell* [UNSW 84/522](holo: UNSW).

Gliophorus pallidus Horak, Beih. Nova Hedwigia **43**: 164 (1973). **Type:** New Zealand. Auckland, 27 June 1968, *E. Horak* [PDD 27090](holo: PDD).

***Misapplied*:** *Hygrocybe pallida* (Horak) A. M. Young, in Young & Wood, Aust. Syst. Bot. **10**: 992 (1997) (nom. illeg. Art. 53.1); non: *Hygrocybe pallida* (A. H. Smith) Singer, Beih. zur Sydowia **7**: 7(1973). *Hygrophorus viridis* sensu Young (1986).

***Illustrations*:** Fuhrer and Robinson (1992): 40; Young & Wood (1997), p975 and p958 as *H. batesii*.

Pileus 11–30 mm, convex becoming umbilicate or plane and depressed at the centre, may become irregularly repand or slightly infundibuliform, smooth, pellucid striate, viscid to glutinous; polychromatic: at first deep, dull green (30E8–28E8) fading with pileus expansion to brown (4B5) but usually darker at the centre (5C8), finally light brown (5C6); or brown (4B5) from the start and becoming lighter (5C6) with maturity and sometimes with orange tints; or deep grass-green (21F8–9) but darker at the centre and retaining this colour throughout the life of the basidiome or fading with age; rain wash may denude old specimens of the green pigments and the pileus then presents a pallid pink appearance. Lamellae broadly adnate with a decurrent tooth to distinctly arcuate or subdecurrent or deeply decurrent, thick, distant, white to tinted green (30B4), often the lamellae colour is lost with maturity and they are then white with the faintest of green tints, margins slightly grey-green and with a fine glutinous thread along the edge. Stipe 16–40(–60) x 1.5–4.0 mm, polychromatic with the same colourations as the pileus although the green tints seem to remain longer on the stipe and may often be found at the base which remains yellowish green, or sometimes with slight yellowish tints at the base which is always paler, viscid to glutinous, cylindrical, hollow, smooth.

Spores (5.0–)5.3–8.0(–8.5) x 3.5–5.0 µm, mean 6.5 x 4.1 µm, Q: 1.3–2.0, mean Q: 1.6, ellipsoid, oblong or amygdaliform, rarely very slightly constricted, hyaline, smooth, non-amyloid. Basidia (25–)30–41(–53) x 5–7 µm, mean 38 x 5.5 µm, Q: (4.4–)5.3–8.0(–9.0), mean Q: 6.5, (2-)4-spored, clavate, clamped at the base and with medallion clamps occasional to frequent. Cheilocystidia densely crowded on lamellae margins and composed of thin-walled, hyaline hyphae, 1.0–5.0 µm diameter and up to 90 µm high, septate, clamped, branching and rounded at the tips, simple to carunculated or finely branched at the tips or contorted and often sinuous, embedded in a gluten layer along the lamella margin. Pleurocystidia none. Hymenophoral trama regular, composed of hyaline, inflated, thin-walled, clamped cells 26–70 x 4–25 µm. Pileipellis an ixotrichoderm of fine, thin-walled, hyaline, clamped hyphae 2.0–4.0 µm diameter, branching, rounded at the tips and embedded in a layer of gluten up to 130 µm thick, subpellicle of shorter, clamped cells 20–60 x 4–12 µm. Stipitipellis an ixotrichoderm similar in structure to the pileus with hyphal caulocystidia identical in size and shape to cheilocystidia. Fig. 4.

***Habitat and distribution*:** Solitary to gregarious in 2's or 3's or caespitose or in troops on soil amongst litter in rainforest or eucalypt forest; also amongst moss in cool temperate forests of Tasmania.

***Specimen examined*: New South Wales**. Lane Cove Bushland Park, 33°49'S 151°10'E, 20 June 1998, *R. & E. Kearney (Young* 2170 in BRI).

***Remarks*:** In the Sydney region, *H. graminicolor* occurs frequently in the litter accumulation areas below overhanging rock shelves where the water run-off from rain is concentrated. Dried material loses its green colour and becomes brick-pink.

H. graminicolor is now known to be polychromatic and the taxon previously accepted as *H. batesii* is now confirmed as one of the extreme colour variants of this very variable taxon. The problems resolved here amply illustrate the difficulties of describing new taxa from herbarium material, even when good collections exist and excellent field descriptions are held. The polychromatic nature of *Hygrocybe graminicolor* was brought to the author's attention by Mr. Alan Mills of the University of Tasmania and has now been confirmed from extensive collections in both Tasmania and New South Wales. Basidiomes with all possible colours or colour mixtures from grass green to orange brown can be seen in these troops which numerous observations strongly suggest are derived from a single mycelium in each case.

The species *Gliophorus pallidus* Horak was illegitimately transferred to the genus *Hygrocybe* by Young in Young and Wood (1997) as *Hygrocybe pallida*. Two Australian

collections, UNSW 86/234 and UNSW 92/207 were cited as belonging to this New Zealand taxon. Re-examination of the field descriptions and the macro- and micro-data held for these collections has conclusively determined that both are representative of the very pale brown form of *Hygrocybe graminicolor*. The field notes for each collection clearly state that there is a green tint at the base of the stipe and this, with the remainder of the data allows of no doubt as to the above re-determination. Examination of the holotype of *Gliophorus pallidus* has shown that its spore and basidial measurements, the macro- and micro-structures and particularly the cheilocystidial structure are typical of the species *Hygrocybe graminicolor*. (See Figure 4.). The watercolour by Marie Taylor (1970) stated by Horak (1990) to be identical to *Gliophorus pallidus* is also typical of the light brown end of the colour range for *Hygrocybe graminicolor*. There is little doubt that *Gliophorus pallidus* was erected on a similar basis as for *Hygrocybe batesii* and that *Gliophorus pallidus* represents the brown end of the colour range of *Hygrocybe graminicolor* in New Zealand.

13. Hygrocybe kula Grgurinovic, Larger Fungi of South Australia: 336 (1997). **Type:** New South Wales. Royal National Park, 15 July 1916, *J. B. Cleland* [AD 5716](holo:AD).

***Illustration*:** Young & Wood (1997), p980.

Pileus 7–30 mm, convex then becoming rather flattened and occasionally centrally depressed; dry; smooth or often mealy; brilliant crimson, (near 8A8 10A8); margins crenulate (especially when young) to even, not cracking, may be yellow tinted. Lamellae broadly adnate with a slight decurrent tooth; veins often present on the upper lamellae surfaces and on the pileus undersurface, thick, widely spaced, pure white becoming cream coloured (3A2 4A2)with age, margins concolorous. Stipe 11–35 x 2–3 mm; more or less cylindrical although occasionally with a tendency to become flattened and frequently is sinuous; firm; smooth; dry; at first brilliant crimson, but paling with age and may become pinkish cream; the base has a tendency to become yellow tinted and this may spread upwards. Odour none, taste mild.

Spores 6.5–10.0 x (3.5–)4.0–7.0 µm, mean 8.4 x 5.4 µm, Q: 1.3–1.9, mean Q: 1.6, oblong to ellipsoid and occasionally slightly constricted medially, apiculus prominent 1–2 µm. Basidia 27–40 x 6–9 µm, mean 36 x 6 µm, Q: 4.5–7.6, mean Q: 5.6, narrowly clavate, 2- or 4-spored, clamped. Cystidia absent. Hymenophoral trama regular, composed of cylindrical, clamped, and occasionally inflated elements 25–60(–100) x 2–10 µm; lactifers present as highly refractive, tortuous and sometimes branching, clamped hyphae 2–4 µm. Pileipellis a cutis of clamped hyphae, 3–5 µm diameter; lactifers occasionally present and similar to those in the hymenophoral trama. Stipitipellis a cutis of hyaline, thin-walled, clamped hyphae 3–5 µm.

***Habitat and distribution*:** On soil in rainforest or at least in very sheltered locations; gregarious to caespitose. Recorded from South Australia, New South Wales and Queensland.

***Specimen examined*: New South Wales.** Lane Cove Bushland Park, 33°49'S 151°10'E, 7 June 1998, *R. & E. Kearney*, (*Young* 2078 in BRI).

***Remarks*:** This species resembles *H. miniata* (Fr.: Fr.) Kummer which differs by having yellow-pink lamellae and a pileipellis that is a trichoderm. A second bright red taxon with white lamellae is *Hygrocybe lanecovensis* which can be distinguished by its deeply decurrent lamellae and distinctly viscid pileus and stipe both of which remain viscid at least until the basidiome is half expanded.

14. Hygrocybe lanecovensis A. M. Young, **sp. nov**. Pileus 10–23 mm, scarlatinus, convexus, viscidus diende viscidulus vel siccus, glaber, ad marginem crenulatus et flavus. Lamellae decurrentes, albae, diende flavidus, ad marginem concolores. Stipes 25–50 x 2–5 mm, scarlatinus, viscidus diende viscidulus vel siccus, cylindricus, glaber. Sporae (6.0–)6.7–8.0 x 3.7–5.0(–5.3) µm, Q: 1.4–1.9, ovoideae vel ellipsoideae, aliquot subconstrictae. Basidia 32–47 x (7–)8–10.5 µm, Q: 4.0–6.2, (2-)4-spora, fibulata. Cystidia nulla. Trama hymenophoralis regularis, fibulata. Epicutis pilei ixocutem formans. Gregaria vel caespitosa in humo sylvestri. **Type:** New South Wales. Lane Cove Bushland

Park. 33°49'S 151°10'E, *R. & E. Kearney & A. M. Young* [DAR 73917](holo: DAR).

Pileus 10–23 mm, brilliant scarlet (10A8 but brighter in hue), convex, viscid but soon becoming almost dry and only faintly sticky at maturity, smooth, margins crenulate and very finely edged with yellow. Lamellae pure white at first and remaining so until at least half matured, then faintly yellow tinted (4A2) especially when old, deeply decurrent, margins even and concolorous. Stipe 25–50 x 2–5mm, brilliant scarlet (10A8 but brighter in hue), viscid and tending to remain somewhat viscid until about half matured and then becoming sticky at most, smooth, cylindrical or tapered downwards, pith filled.

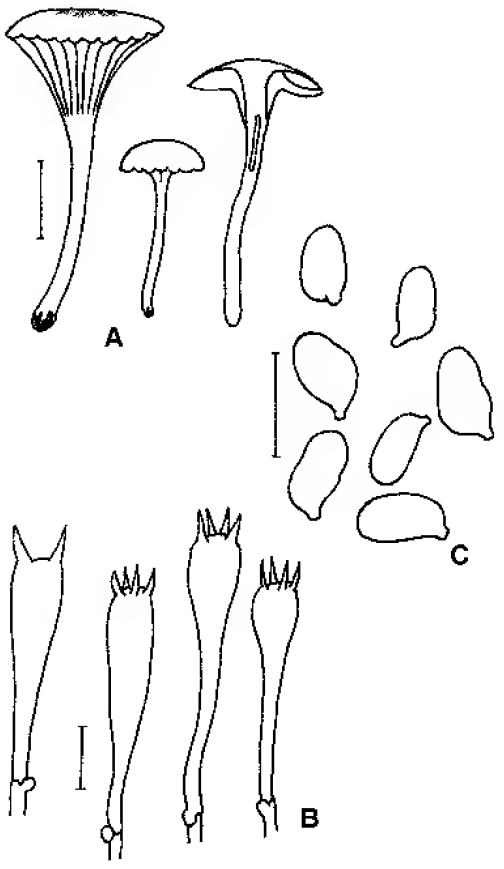

Fig. 5. ***Hygrocybe lanecovensis***. A. Habit (bar = 10 mm); B. basidia; C. spores (bar = 10 µm). Holotype DAR 73917.

Spores (6.0–)6.7–8.0 x 3.7–5.0(–5.3) µm, mean 6.9 x 4.2 µm, Q: 1.4–1.9, mean Q: 1.7, ovoid, long ellipsoid or sub-cylindrical and then often a little constricted, smooth, hyaline, non-amyloid. Basidia 32–47 x (7–)8–10.5 µm, mean 40 x 8.6 µm, Q: 4.0–6.2, mean Q: 4.6, 2- or 4-spored basidia present in more or less equal numbers and apparently without differences in either basidial sizes or spore sizes, clamped. Cystidia absent. Hymenophoral trama regular and composed of chains of hyaline, thin walled, cylindrical or inflated ellipsoid to subglobose elements 17–58 x 3–20 µm, clamps present. The tramal elements become increasingly subglobose to globose towards the lamellae margins. Pileipellis a loose ixocutis of repent to slightly interwoven hyaline, thin walled, cylindrical, septate hyphae 1.5–7.5 µm diameter, clamps present. Stipitipellis an ixocutis of repent, septate, hyaline, thin walled, cylindrical hyphae 1.5–7.5 µm diameter, clamps present. Fig. 5.

Habitat: Gregarious, caespitose or in troops on sandy soil amongst leaf litter in wet sclerophyll forest or rainforest.

Specimen examined: **New South Wales**. Lane Cove Bushland Park, 33°49'S 151°10'E, 23 August 1998, *R. & E. Kearney* (*Young* 2191 in BRI).

Remarks: The only other taxon that approaches this species is *Hygrocybe kula* which has a dry pileus and stipe and adnate rather than the deeply decurrent lamellae present in this taxon. Its spectacular colouration with pure white and decurrent lamellae coupled with the brilliant red pileus and stipe make it extremely distinctive. The ixocutis is quite distinct when the species is first emerging and the stipe is so viscid/slippery as to make the basidiomes difficult to gather. The viscidity vanishes quite quickly from the pileus but is retained for a longer period on the stipe. Some collections seem to have the yellowish tint appear earlier in the development of the basidiome but the colour is always quite pale. It is very widespread and plentiful at the holotype locality.

Etymology: from Lane Cove Bushland Park, the holotype locality.

15. Hygrocybe stevensoniae May & Wood, Mycotaxon **54**: 147–150 (1995); *Hygrophorus viridis* G. Stevenson, Kew Bull. **16(3)**: 383 (1963); *Gliophorus viridis* (G. Stevenson) Horak, Beih. Nova Hedwigia **43**: 173 (1973); non *Hygrocybe viridis* Capelari & Maziero, Mycotaxon **33**: 192 (1988). **Type:** New Zealand. Levin, 26 June 1948, *G. Stevenson* [*Stevenson* 338 in K](holo: K).

***Misapplied*:** *Hygrophorus psittacinus* sensu Cleland and Cheel (1919) and Willis (1963); *Hygrocybe psittacina sensu* Shepherd and Totterdell (1988).

***Illustrations*:** Fuhrer and Robinson (1992), p. 41; Young & Wood (1997), p998.

Pileus 10–30(–35) mm, convex to conico-convex expanding to more or less plane in older basidiomes, occasionally with the pileus centre a little depressed, smooth, viscid to glutinous, apple-green to dark green (27C8–27D8) and always darker at the centre, usually yellowish at the margins, pellucid striate in light and dark green for at least half of the pileal radius and often completely, margins even or slightly crenulate. Lamellae adnate with decurrent tooth or arcuate, distant, thick, white with greenish tints to more or less pallid green, margins concolorous, even and without glutinous thread. Stipe 30–40 x 1–3.5 mm, cylindrical to flattened, smooth, viscid to glutinous, green, sometime yellowish at the base.

Spores 6.0–8.0(–10.5) x (3.3–)4.0–5.3(–6.0) µm, mean 7.1 x 4.4 µm, Q: 1.4–1.9(–2.1), mean: Q 1.6, oblong to ellipsoid, smooth, non-amyloid. Basidia 30–45 x (5–)6–9 µm, mean 38 x 7 µm, Q: (3.5–)5.1–7.3, mean Q: 6.0, 4-spored, clamped at the base. Cystidia absent. Hymenophoral trama regular, composed of inflated, hyaline, thin-walled, cylindrical to ellipsoid or subglobose elements, 14–57 x 4.5–15.5 µm, clamps present. Pileipellis an ixotrichoderm with septate, clamped hyphae 2–5 µm in diameter embedded in a layer of gluten 100–150 µm thick, apices usually clavate. Stipitipellis an ixotrichoderm similar to the pileipellis but without the inflated subpellicular layer.

***Habitat and distribution*:** Gregarious on soil in rainforest or sclerophyll forest amongst litter and usually on soil. Recorded from New South Wales, Tasmania and New Zealand.

***Specimens examined*: New South Wales.** Lane Cove Bushland Park, 33°49'S 151°10'E. 7 June 1998, *R. & E. Kearney* (*Young* 2076 in DAR); 13 June 1998, *A. M Young* (*Young* 2112 in BRI).

***Remarks*:** Of the two viscid, green taxa found in the Lane Cove Bushland Park, *H. stevensoniae* appears to be the least common taxon and is readily distinguished from *H. graminicolor* because *H. stevensoniae* lacks cheilocystidia embedded in a marginal gluten thread.

Subgen. **Humidicutis** Singer, Sydowia 2: 28 (1948). **Type:** *Hygrophorus marginatus* Peck.

Hymenophoral trama regular, composed of short, cylindrical to inflated (often moniliform) elements 20–300 µm long; basidiome variously coloured white, pink, dull orange, yellow, or lilac; pileus usually conical becoming umbonate or plane and frequently splitting radially; lamellae narrowly adnate, adnexed or more or less free; cystidia absent; clamps absent throughout the basidiome except at the bases of the basidia and then frequently of medallion form.

16. Hygrocybe lewellinae (Kalchbrenner) A. M. Young, Aust. Syst. Bot. **10**: 1011 (1997); *Hygrophorus lewellinae* Kalchbrenner, Proc. Linn. Soc. N.S.W. **7**: 105 (1882). **Type:** Victoria. Western Port, 14 June 1880, *M. M. R. Lewellin*, [MEL, RB Mss A11](holo: MEL)

***Illustrations*:** Cole, Fuhrer and Holland (1978), plate 3; Young & Wood (1997), p1012.

Pileus 30–65 mm, conical becoming umbonate to almost plane, dry, smooth but innately radially fibrillose, wholly lilac (15B4–16A3) except for the umbo which is usually rather more greyish or greyish brown, whole surface fading with age, often splitting radially at the margins. Flesh very thin, pallid lilac but very dark lilac just under the pileal cuticle. Lamellae narrowly adnate or commonly adnexed to more or less free, if adnate then often breaking free

of the stipe as the pileus expands, pallid lilac, moderately thick, widely spaced and margins concolorous. Stipe 50–70 x 4–8 mm, smooth, dry, hollow, equal but occasionally tapering, pale lilac but sometimes slightly yellowish (4A4) at the extreme base, stipe flesh lilac.

Spores 7.0–11.5 x 4.5–6.0 µm, mean 8.0 x 5.0 µm, Q: 1.3–2.3, mean Q: 1.6; shape variable, subglobose to ovoid or amygdaliform, occasionally almost rectangular, smooth, hyaline, thin-walled, non-amyloid. Basidia 32–41x 8–10 µm, mean 35 x 9 µm, Q: 2.9–5.1, mean Q: 4.1, 2- or 4-spored, medallion clamps frequent. Cystidia absent. Hymenophoral trama regular, composed of short, parallel, hyaline, thin-walled, septate hyphae and a mixture of cylindrical to inflated hyphae, 26–80 x 5–20 µm, clamps absent or very rare; lactifers present as highly refractive, thin-walled, hyaline, straight to highly contorted and branching hyphae 3–8 µm. Pileipellis a cutis, 40–50 µm thick, composed of thin-walled, septate, hyaline, repent hyphae 4–6 µm diameter with occasional free ends above the surface, clamps absent or very rare, overlaying a subpellicle of inflated, hyaline, thin-walled, ovoid to subfusoid (occasionally subglobose) cells 45–100 x 20–40 µm, clamps absent or very rare; lactifers present similar to those in the hymenophoral trama. Stipitipellis a cutis of hyaline, thin-walled, septate hyphae 2–4 µm, clamps absent.

Habitat and distribution: Solitary or gregarious on soil amongst leaf litter or amongst moss in forests; common in Tasmania and and also recorded from Victoria and New South Wales.

Specimen examined: New South Wales. Lane Cove Bushland Park, 33°49'S 151°10'E, 13.vi.1998, *A. M. Young*, (*Young* 2102 in BRI).

Remarks: The radial splitting of the pileus which also involves medial splitting of the underlying lamella remains an unusual character shared by this group of taxa which includes the pure white *Hygrocybe mavis* (G. Stevenson) Horak and the pink *Hygrocybe rosella* Horak. Almost all radial splits of the pileal surface occur directly above the medial section of a lamella immediately below and as the split occurs (commencing at the pileus margin) the lamella is 'torn apart' radially along the middle of its hymenophoral trama to give two half lamellae 'membranes' - each 'membrane' composed of a hymenial layer of basidia, the subhymenial layer and half of the hymenophoral trama. These half lamella 'membranes' remain attached to the pileus along their radial lengths and at the original lamella's margin so that an observer looking down through a radial split from above cannot see through the opening, but instead sees a 'V' shaped surface formed by the interior faces of the two 'membranes' of the lamella still attached to the pileus and at the lamella margins.

17. *Hygrocybe* sp. LC1

Pileus 8–20 mm, convex to parabolic becoming broadly convex or occasionally subconical, brilliant scarlet, dry (but may be a very weak ixocutis - see pileipellis description), smooth or very finely and innately fibrillose, margins yellow and striate. Lamellae strongly decurrent, bright yellow, margins even and concolorous, veins present on pileus undersurface and on the upper faces of the lamellae. Stipe 30–50 x 1.5–2.5 mm, brilliant scarlet but yellowish towards the base, cylindrical, dry, smooth or innately finely fibrillose.

Spores (6.0–)7.3–9.7(–12.0) x (3.3–)4.0–4.7 µm, mean 8.4 x 4.1µ m, Q: 1.5–2.2(–3.0), mean Q: 2.0, ellipsoid, ovoid, obovoid, cylindrical or sometimes lacrymoid, hyaline, thin walled, a majority very strongly constricted. Basidia 34–51 x 6–8(–10) µm, mean 40 x 8 m, Q: 4.2–6.7, mean Q: 5.0, 2- or 4-spored, clamps present. Cystidia absent. Hymenophoral trama regular and composed of chains of ellipsoid or cylindrical elements that are hyaline, thin walled 17–56 x 4–16 µm, clamps present. Pileipellis a cutis or weak ixocutis composed of repent to slightly interwoven hyphal elements that are thin walled, hyaline 2.5–10.0 µm diameter, clamps present. The pileipellis hyphae may exhibit gelatinisation, lactifers are present in the subcuticular layers as translucent, sometimes contorted hyphae 3–11µm diameter. Stipitipellis a cutis of repent, hyaline, thin walled, septate, cylindrical hyphae 2.5–4.0 µm diameter, clamps infrequent to occasional. Fig. 6.

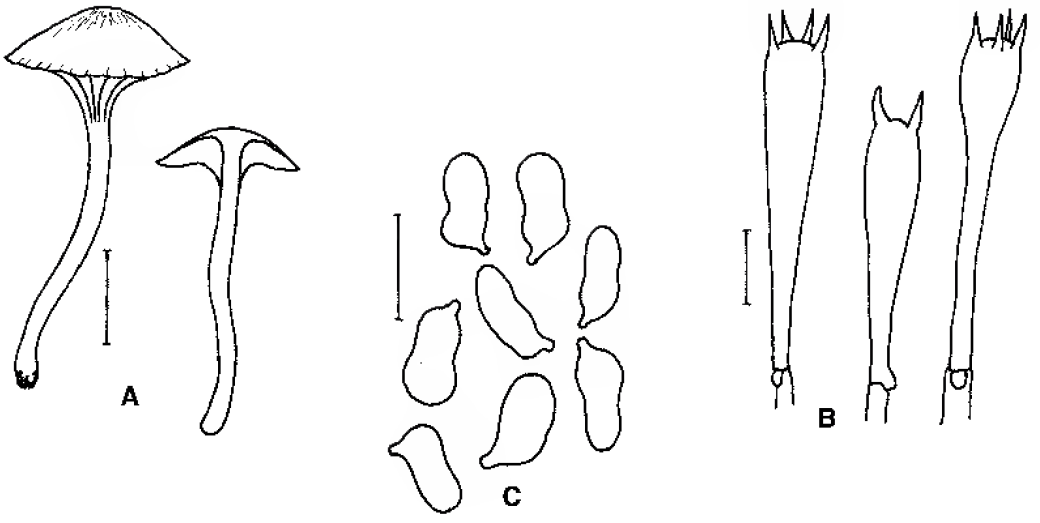

Fig. 6. ***Hygrocybe*** sp. LC1. A. Habit (bar = 10 mm); B. basidia; C. spores (bar = 10 μm). Y2188.

***Habitat*:** Gregarious to subcaespitose on soil and litter, often in 2's and 3's.

***Specimen examined*: New South Wales.** Lane Cove Bushland Park, 33°49'S 151°10'E, 16 August 1998, *R. & E. Kearney*, (*Young* 2188 in BRI).

***Remarks*:** Very small collections of a remarkably beautiful *Hygrocybe* are held for what is believed to be a new species in the genus. Insufficient material is held to permit the full description of a new taxon. The taxon has extremely constricted spores which approach those of *Hygrocybe constrictospora* Arnolds.

Camarophyllopsis Herink, Acta Mus. Horti Bot. Boh. Bor. **1**: 61 (1958). **Type:** C. schulzeri (Bres.) Herink.

Subgen. **Hodophilus** (R. Heim) Bon, Doc. Mycol. **26**: 20 (1996). **Type:** *Hodophilus foetens* (Phill.) R. Heim.

Pileus never trichodermal and always a hymeniderm.

18. Camarophyllopsis kearneyi A. M. Young, **sp. nov.** Pileus 5–11 mm latus, hemisphaericus deinde convexus, glaber, siccus, pallido-brunneus, ad marginem cremeus vel albidus, crenulatus. Lamellae adnatae vel dente decurrente vel arcuatae, albidae, distantes, ad marginem concolorae. Stipes 15–27 x 1.5–2.5 mm, siccus, pallido-brunneus, fibrillosus, cylindricus. Sporae (4.0–)4.3–5.7 x 4.0 5.3(–5.7) μm, Q: 1.0–1.2(–1.3), subglobosae usque globosae, hyalinae, inamyloideae. Basidia 44–62 x 5.6–8.9 μm, Q: 6.2–8.6, 4-spora, defibulata. Cheilocystidia 18–44 x 3–7 μm, hyalina, cylindricata, sinuosa, defibulata. Pleurocystidia nulla. Trama hymenophoralis regularis, haud fibulata. Epicutis pilei epithelium formans. Gregaria vel caespitosa in humo sylvestri. **Typus:** New South Wales. Lane Cove Bushland Park. 33°49'S 151°10'E. 13 June 1998, *R. & E. Kearney* [DAR 73919](holo: DAR).

Pileus 5–11mm, at first often nearly spheroid then becoming hemispherical or deeply convex; smooth but finely micaceous under a x8 lens; dry; pallid brown (5C4) with darker centre; margins crenulate and paler to near white. Flesh very thin and concolorous with pileus surface. Lamellae adnate or with decurrent tooth or arcuate; distant; white to greyish white; margins concolorous and even. Stipe 15–27 x 1.5–2.5mm; pale brown (5C2); dry; surface finely fibrillose with brownish, scattered fibrils, cylindrical, solid.

Spores (4.0–)4.3–5.7 x 4.0–5.3(–5.7) μm, mean 4.9 x 4.6 μm; Q: 1.0–1.2(–1.3); mean Q: 1.1; subspherical to spherical; hyaline, smooth.

Basidia 44–62 x 5.6–8.9 µm, mean 49 x 6.6 µm; Q: 6.2–8.6, mean Q: 7.4; 4-spored occasionally 2-spored; without clamps. Cheilocystidia 18–44 x 3–7 µm, hyaline, often sinuous, clavate or usually more or less cylindrical and capitate

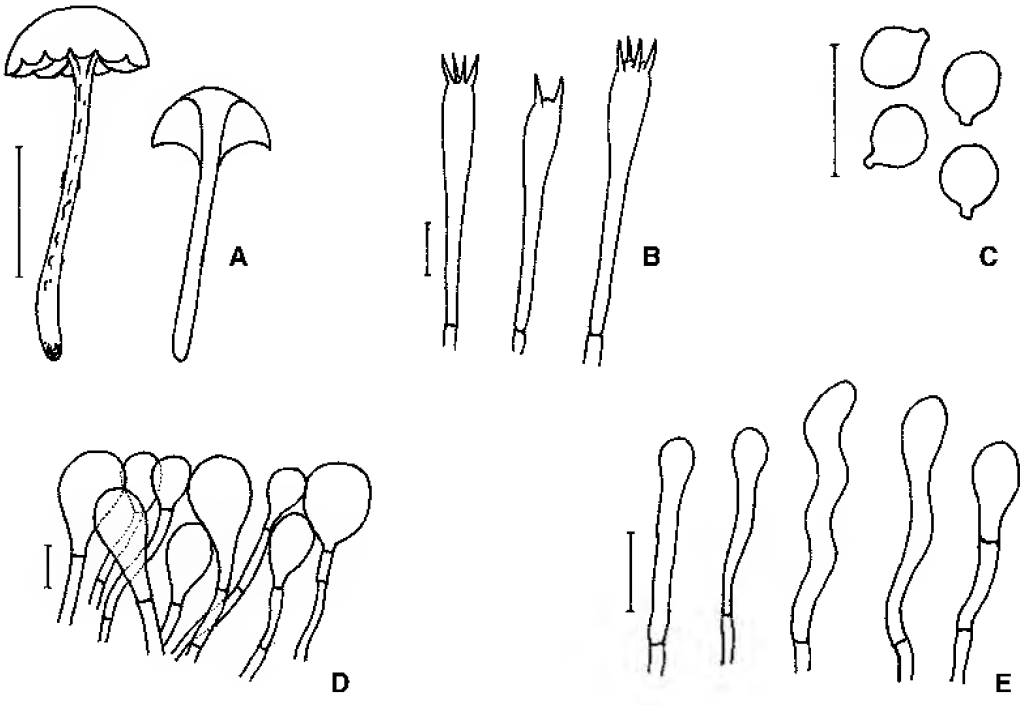

Fig. 7. ***Camarophyllopsis kearneyi.*** A. Habit (bar = 10 mm); B. basidia; C. spores, D. pileipellis; E. cheilocystidia (bar = 10 µm). Holotype DAR 73919

with a pyriform to subglobose apex; septate at the base; clamps absent. Hymenophoral trama regular composed of hyaline, tubular, septate elements 28–56(–90) x 2–8 µm, clamps absent; lactifers not found. Pileipellis an epithelium composed of a layer of globose to pyriform cells 13–23 µm diameter, clamps absent. Stipitipellis a cutis of hyaline, thin walled, septate, tubular elements 4– 8 µm diameter, clamps absent. Caulocystidia scattered or gregarious, similar to the cheilocystidia but usually more contorted 33–67 x 2–8 µm. Fig. 7.

***Habitat*:** Gregarious/caespitose on sandy soil under ferns beside creek in gallery warm-temperate rainforest.

***Remarks*:** This taxon approaches the European species *Camarophyllopsis phaeophylla* (Romag.) Arnolds, but that taxon has no cheilocystidia, an irregular hymenophoral trama and a stipe without the brownish fibrils present in *C. kearneyi*. The species is quite common under ferns on the bank of Gore Creek but its tiny size and subdued colours render it easily overlooked. There may possibly be a second species of *Camarophyllopsis* at the Gore Creek site. Collections of material readily identified as the genus *Camarophyllopsis* have been found caespitose on sandy soils under coachwood (*Ceratopetallum apetalum*). Dried material and descriptions so far have been inconclusive and the coachwood collections may just be a variety of *C. kearneyi*. Collections of a similar taxon are also known from Mt. Wilson in the Blue Mountains – there appears to be only a minor difference in the attachment of the lamellae which seem to be a little more deeply decurrent. Only a very small amount of the Mt Wilson material is held and these results are therefore inconclusive other than the high probability of an extended distribution for the

Gore Creek species.

Etymology: After Professor Ray Kearney, Associate Professor of the Department of Infectious Diseases, University of Sydney, New South Wales.

Acknowledgments

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A new species and a new combination in *Rutidosis* (Gnaphalieae: Angianthinae: Asteraceae).

A.E. Holland

Summary

Holland, A.E. (1999) A new species and a new combination in *Rutidosis* (Gnaphalieae; Asteraceae). Austrobaileya 5(3): 565-572. A new species, *Rutidosis glandulosa* A.E.Holland, is described and illustrated with details on habitat and conservation status. A new combination, *R. helichrysoides* subsp. *acutiglumis* (Philipson) A.E.Holland, is made with notes on the variation and distribution of *R. helichrysoides*. A key to the species of *Rutidosis* is given.

Keywords: *Rutidosis, Rutidosis glandulosa, Rutidosis helichrysoides* subsp. *acutiglumis, Rutidosis helichrysoides* subsp. *helichrysoides.*

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1. Rutidosis glandulosa A.E.Holland, **sp. nov.** Species affinis *R. murchisonii*, a plantis dense glandulosis pilosis, bracteis involucratibus ciliatis ad apicem, pappi squamis linearibus, longioribus (1.5–2.5 mm longis), angustioribus (c. 0.2 mm latis) differt. **Typus:** Queensland. LEICHARDT DISTRICT: Blackdown tableland, c. 32 km SE of Blackwater, campsite on Mimosa Ck, Apr 1971, *R.J.Henderson* 628, *S.B.Andrews & P. Sharpe* (holo: BRI; iso:CANB, MEL).

Rutisosis sp. (Blackdown Tableland K.A. Williams 79082), Schedule (Jan. 1998) of the Queensland Nature Conservation Act 1992, p. 10; R.J. Henderson, Queensland Plants, Names & Distribution, p. 32 (1997).

Erect or ascending herb with a woody base. Stems often branched from base, 13–30 cm long, densely glandular hairy; hairs variable in length, very short (2-celled) to longer (several cells, 2-celled at apex). Leaves sessile, linear to narrowly obovate, 9–70 mm long, 1.5–5 mm wide, acute and apiculate at apex; margins entire and usually recurved; both surfaces densely glandular hairy, green, with 1 vein. Peduncles 2–7cm long, distantly scaly, densely glandular hairy. Capitula hemispherical, 9–21 mm diam., with several rows of involucral bracts and 30–70 florets. Outer involucral bracts sessile, ovate, 1.5–7 mm long, 2–4 mm wide, acute and ciliate at apex with cilia up to 0.5 mm long; lamina scarious, smooth, golden brown; lower part glandular, with an obovate stereome c. 1 mm long and wide, with a narrow margin. Inner bracts similar, lanceolate to linear, 5–8 mm, long, 1–2 mm wide; lower part claw-like, with stereome 2–3 mm long, 1–1.5 mm wide. Florets ±equalling the involucral bracts, mainly bisexual with a few female outer florets. Corolla 4–5.5 mm long, yellow, glabrous; lower part of tube narrow, upper part slightly wider, 1.5–2 mm long, 0.7–1 mm wide; lobes 5, triangular, 0.7–1.2 mm long. Anthers c. 1.5 mm long; apex narrowly triangular, c. 0.2 mm long, tails absent. Style arms truncate, 0.5–1 mm long (–1.5 mm long in female florets), papillose at apex. Cypselas obovoid, truncate at apex, 1–1.4 mm long, 0.5–0.7 mm wide, dark brown, glabrous, shiny; the surface covered with large translucent 2-celled papillae; vascular strands 2. Pappus scales 8–11, linear, 1.5–2.5 mm long, c. 0.2 mm wide, tapered to a fine point at apex, ciliate with long hairs, shiny, white. Fig. 1.

Specimens examined: **Queensland**. LEICHARDT DISTRICT: Gwambagwine, Ruined Castle Ck catchment, Sep 1995, *Forster* PIF17825 et al. (BRI); Blackdown

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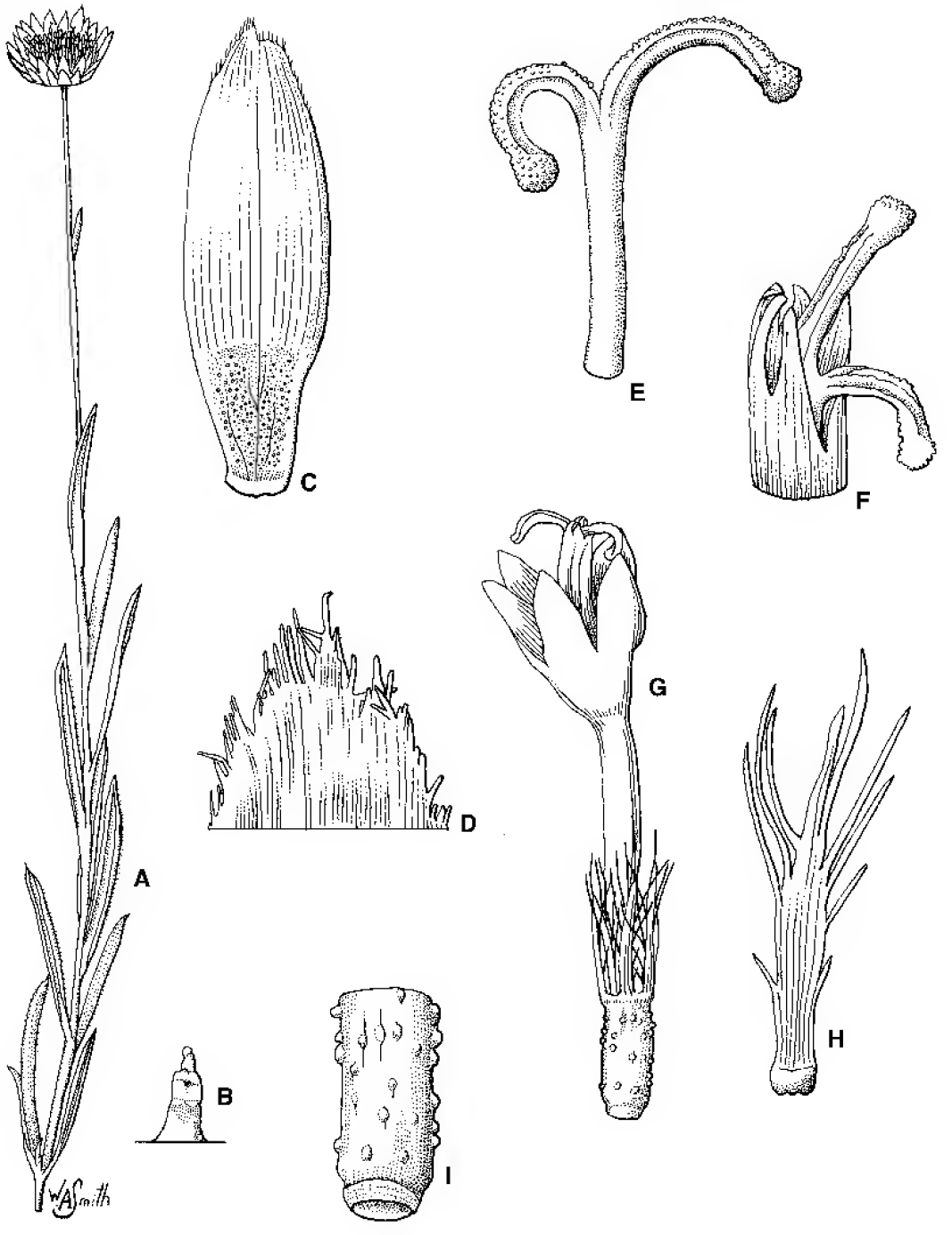


Fig. 1. ***Rutidosis glandulosa***: A. flowering stem x 1. B. leaf gland x 40. C. involucral bract x 10. D. apex of involucral bract x 30. E. style arms x 40. F. anther apices x 40. G. floret with cypsela and pappus scales x 15. H. pappus scale x 40. I. cypsela x 40. (from *R.J.F.Henderson* 628, BRI).

Tableland, c. 32 km SE of Blackwater, campsite on Mimosa Ck, Apr 1971, *Henderson* 628 et al. (BRI, CANB, MEL); Blackdown Tableland, May 1981, *Pearson* 189 (BRI); Blackdown tableland near Mimosa Ck, Sep 1979, *Williams* 79082 (BRI). DARLING DOWNS DISTRICT: Barakula, Nov 1979, Hando 120 (BRI); Barakula State forest near Chinchilla, Feb 1986, *Robinson* 860196 et al. (BRI); Thulimbah, without date, *Schindler* s.n. (BRI).

Distribution and habitat: This species has been collected from four disjunct localities in Queensland,viz: Blackdown Tableland, Gwambagwine, Barakula State Forest (near Chinchilla), and Thulimbah near Stanthorpe (probably no longer extant at this locality). It occurs on sandy or gravelly well drained soil in grassy open *Eucalyptus* woodland. Map. 1.

Conservation status: *Rutidosis glandulosa* is presently listed as Rare in the 1998 Schedule of the Queensland Nature Conservation Act 1992. The population at Barakula comprised fewer than 50 plants at the time of collection, growing alongside a forestry track. The Thulimbah population (*Schindler* s.n.) has not been relocated. The populations at Gwambagwine and Blackdown Tableland consist of several hundred plants (P.I.Forster, pers. comm., 1998).

Note: This species most closely resembles R. *murchisonii* but differs mainly in the dense vestiture of glandular hairs; woolly hairs are absent. It is also distinguished by the involucral bracts which are ciliate at the apex and by the pappus scales which are linear, 1.5–2.5 mm long and c. 0.2 mm wide. *R. murchisonii* has woolly hairs at least on the lower surface of the leaf, and lacks glandular hairs. The involucral bracts are entire, and the pappus scales are obovate, 1–1.5 mm long and more than 0.2 mm wide.

This new species occurs further west than *R. murchisonii*, it's present distribution overlapping that of *R. murchisonii* between Roma and Chinchilla (see Map 1).

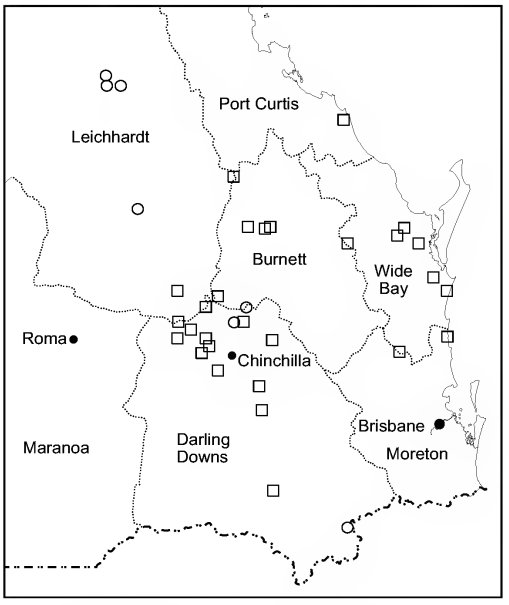
2. Rutidosis helichrysoides DC., Prodr. 6: 159 (1838). **Type:** New South Wales."In Novae-Hollandiae Molle's-Plains prope Lachlan flumen julio flor. ligit", *A. Cunningham* (holo:G-DC; iso: K [photo at BRI]).

R. auricoma F.Muell., Linnaea 25: 408 (1853). **Type:** "Ad margines rivulorum exsiccantium lapidosos montium prope Cudnaka", n.v., fide Bentham, Fl.Aust. 3: 594 (1866).

Erect herb 25–60 cm tall with a woody base. Stems branched, densely to sparsely white woolly hairy. Leaves mostly cauline, alternate, sessile, linear to oblong or oblanceolate (lowest ones obovate), 0.6–9.0 cm long, 2–20 mm wide; apex acute or obtuse, often apiculate; margins recurved or flat; lamina sparsely to densely white woolly hairy on both surfaces, denser below, 1-veined, lowest leaves often 3-veined. Peduncles 0.5–7 (–15) cm long, sparsely to densely white woolly hairy, distantly scaly. Capitula broadly hemispherical, 6–20 mm diam., with several rows of involucral bracts and 50–200 florets. Outer involucral bracts sessile, ovate to lanceolate, 4–7 mm long, 0.4–2.2 mm wide, acute at apex, entire or with cilia up to 0.6 mm long; lamina strongly or slightly transversely wrinkled or flat, scarious, translucent, golden or pale brown; lower part, with a flat obovate stereome 0.5–2.0 mm long, 0.3–1.2 mm wide, glandular, with or without a narrow margin. Inner bracts similar, lanceolate to linear, 5–7 mm long, 0.3–2 mm wide, narrowly tapered to a long point at apex; lower part claw-like with stereome 1–3 mm long, 0.3–0.7 mm wide. Florets equal to or longer than the involucral bracts, all bisexual. Corolla 3–4 mm long, bright yellow or golden, glabrous; lower part of tube narrow; upper part of tube dilated, 1–1.5 mm long, c. 0.7 mm wide; lobes 5, triangular, 0.7– 1.0 mm long. Anthers 1.1–1.3 mm long; apex ovate c. 0.2 mm long; tails absent. Style arms truncate, 0.2–0.6 mm long, papillose at apex. Cypselas narrowly obovoid, obliquely truncate at apex, 0.6–1.3 mm long, 0.3–0.5 mm wide, light or dark brown, glabrous, shiny, the surface covered with large 2-celled papillae; vascular strands 2. Pappus scales 5–12, obovate to spathulate, 0.8–1.4 mm long, 3–6 mm wide, rounded or truncate at apex, entire, shiny, white or cream.

Variation in *Rutidosis helichrysoides* W.R.Philipson (1937) distinguished his species, *Rutidosis acutiglumis* from *R. helichrysoides* DC. by "the numerous narrow outer involucral bracts and the lanceolate and

paleaceous apices of the inner bracts. In *R. helichrysoides* the bracts are ovate with a ciliate margin and are golden brown." An



Map 1. Distribution of ○ *R. glandulosa*, and □ *R. murchisonii*.

investigation into the variation of involucral bract characters showed that size, shape, margin, colour and wrinkling of the lamina are variable across the entire range of these taxa (see Fig. 2).

Bract widths (of widest bracts) were measured for 60 specimens from across Australia (see Fig. 3). Two groupings occur, corresponding to the two taxa described as subspecies below. Many of the Queensland specimens have narrow, entire, pale bracts with little or no wrinkling *(R. helichrysoides* subsp. *acutiglumis*), while those further south have variously wide to narrow bracts, different degrees of wrinkling and short or long cilia (*R. helichrysoides* subsp. *helichrysoides*). Intermediates occur in the Gregory South District of Queensland and in north-eastern South Australia at Coongie and in the Northern Territory. These intermediates have narrow involucral bracts (0.5–0.8 mm wide) with a wrinkled lamina and marginal cilia to 0.3 mm long. eg. *D.E.Boyland* 182, *Henderson & Boyland* H2114, *Halford* 2678A, *Williams* 8054, *Jackson* 1991 and *O'Malley* 169. A few specimens from the Northern Territory have bracts as wide as the southern specimens (1.0–1.4 mm wide), but with a smooth entire lamina eg. *Barrit* 21 and *Nielson* 428.

Specimens from the southern part of South Australia have dense inflorescences with smaller capitula on shorter peduncles, often crowded together. This form is not recognised as a distinct taxon here. The name *R. panniculata* E.Pritzel (Feddes Rep. 15 (1918), Type: Central Australia, 1903, *Basedow* 20) may be associated with this part or the variation but I have been unable to locate the type material to confirm this.

Two subspecies are recognised:

Involucral bracts usually 0.8–1.5 mm wide, brown to golden yellow, strongly horizonatally wrinkled, with cilia usually more than 0.2 mm long ..... **R. helichrysoides** subsp. **helichrysoides**

Involucral bracts 0.2–0.8 mm wide, pale brown, smooth or very slightly horizontally wrinkled, entire or with short cilia less than 0.2 mm long ..... **R. helichrysoides** subsp. **acutiglumis**

Rutidosis helichrysoides subsp. **helichrysoides**

Capitula with involucral bracts usually 0.8–1.5 mm wide; lamina transversely wrinkled, brown or golden yellow, with cilia up to 0.6 mm long.

Selected specimens: **Western Australia**. Carnegie Stn, ENE of Meekatharra, July 1967, *Beard* 4811 (PERTH); Near E end of Schwenin Mural Ct, July 1974, *George* 12098 (CANB); Near Rudall R., May 1971, *George* 10681 (CANB, PERTH); 67 miles [107 km] E of Warburton, July 1963, *George* 4734 (PERTH); 35 miles [56 km] SE of Windulda, Warburton Rd, Aug 1962, *George* 4023 (PERTH); 4 miles [6.4 km] W of Mt Tietkens, northern Gibson Desert, July 1967, *George* 8962 (PERTH); Mt Malcolm, July 1899, *Fitzgerald* s.n. (PERTH); Mt Windell Rd corridor, 8 km NW of Mt Windell, Mar

1992, *van Leeuwen* 1114 (PERTH); 10 km W of Juna Downs HS, Jan 1989, *Mitchell* 1707 (PERTH); 28 miles [44.8 km] SE of Gordon Downs Stn, July 1949, *Perry & Lazarides* 2489 (AD, BRI, PERTH); Jigalong Depot, May 1947, *Royce* 1533 (PERTH); E of Warburton Mission on road from Kalgoolie to Ayers Rock, May 1959, *Vollprecht* 43 (PERTH); Newman, July 1980, *Walker* 4 (PERTH); Rudall R. area, Aug 1971, *Wilson* 10568 (PERTH). **Northern Territory**. Atcherie Ck crossing by Ammaroo-Ilkedra Rd, c. 3.7 km by road N of Honeymoon Bore, Aug 1978, *Barker* 2802 (AD); Kulgera, Nov 1955, *Burbidge & Alsray* 4584 (AD, CANB); 0.7 km E of the Sandover Hwy on the Plenty Hwy, Sep 1982, *Chinnock* 5538 (AD); 66 miles [105.6 km] NW Willowra HS, Dec 1965, *Chippendale* 4812 (AD, CANB, DNA); 1 mile [1.6 km] E No. 6 Bore, Manner's Ck, Oct 1955, *Chippendale* 1789 (AD);); 19 miles [30.4 km] SE Bottom Bore, Hale R., Jan 1966, *Chippendale* 4939 (AD, CANB, DNA); Mulga Park Stn, Apr 1974, *Henshall* 182 (AD); Peterman Ranges Area, Apr 1972, *Latz* 2405 (DNA); Goose R., McLaren Ck Stn, Sep 1983, *Latz* 9812 (DNA); 20 miles [32 km] SW of Lucy Ck Stn, Sep 1956, *Lazarides* 5906 (CANB); 11.5 miles [18.4 km] SE of Alice Springs Township, Aug 1956, *Lazarides* 5713 (AD, CANB); Charley Ck c. 60 miles [96 km] NW of Stuart Highway along Yuendumu Rd, Sep 1968, *Maconochie* 595 (AD); 90 miles [144 km] W Stuart Hwy, Yuendumu Rd, July 1968, *Must* 301 (AD); 20 miles [32 km] N of Aileron, June 1962, *Nelson* 428 (AD, BRI); Phillip Ck, c. 46 km N of Tennant Ck, July 1968, *Orchard* 909 (AD); By west base of Ayers Rock, c. 350 km SW of Alice Springs, Aug 1957, *Schodde* 404, (AD, CANB). **South Australia**. 7.5 km N of Screechowl Ck, 12 km SW of Alberrie Ck Rd, Finnis Springs Stn, Aug 1990, *Badman* 4303 (BRI); Wimbrinna Dam, Gregory Ck, Stuart Ck Stn, Aug 1989, *Badman* 3548 (AD); Kingoonya-Mt Eba, East West Railway C'mm'th Hill, Apr 1917, *Basedow* 33 (NSW); Eyre Basin, Arckaringa, July 1989, Bates 19167 (BRI); Coongie sandhills, Oct 1986, *Conrick* 1953 (AD); Mt Carmeena, c. 25 km WSW of Everard Park HS, Sep 1963, *Eichler* 17511 (AD); Koodnanaie Ck, Birdsville Ck, Sep 1960, *Filson* 3310 (AD); 104 miles [166.5 km] S of Birdsville, 47 miles [75.6 km] N of Mirra Mitta Bore, Sep 1979, Grandison 161 (AD); *Warburton R., near New Kalamurina Stn, Mar 1972, *Jackson* 1991 (AD); Near Warburton R., c. 11 km SW of New Lalamurina, Aug 1975, *Jessop* 2022 (AD); Mt Lyndhurst, Sep 1998, Koch 135 (NSW, PERTH); 32 km NE of Innamincka, Aug 1968, Kuchel 2558 (AD); *Coongie Lakes, NW branch of Coopers Ck, Jan 1987, *O'Malley* 169 (AD); 15 km SW of Dickina Hill, Pandie Pandie Stn, May 1987, *Reid* 814 (AD); Lagoon Waterhole, Quadrat MC6I Lake Eyre, Sep 1988, *Robinson* 919 (BRI); Everard Range, Sep 1968, *Spooner* 154A (AD); Lake Gairdner area, near Kingoonya, Sep 1967, *Spooner* 201 (AD); W of Dalhousie Springs complex, Red Mulga Ck 6.4 miles [10.4 km] W of Witchery Mound, Sep 1974, *Symon*, 9382 (AD); 18 miles [28.8 km] S of Mt Hopeless outstation, Aug 1968, *Symon* 5938 (AD); 45 km NNW of Innamincka along track on sandy plain, Aug 1975, *Weber* 4705 (AD); Watchiepandrinie Ck, 15.5 km W of Innamincka, May 1976, *Williams* 8132 (AD). **Queensland**. WARREGO DISTRICT: 20 miles [32 km] E of Cunnamulla, Sep 1963, *Phillips* s.n. (BRI). **New South Wales**. North Mandelman Paddock, Fowlers Gap near Broken Hill, Oct 1975, *Jacobs* 2208 (NSW); Calindary Stn, Apr 1967, Libke 24570 (CANB); Environs of Cobar, Nov 1969, *McBarron* 18485 (NSW); New Clunie, c. 27 km W of Louth, Apr 1967, *Moore* 4967 (NSW); Pelora c. 60 km NW of Loath, Oct 1989, *Moore* 7951 (NSW); Gemanna, Oct 1988, *Moore* 8921 (BRI, NSW); 1.5 km NE Wonga, May 1972, *Pickard & Benson* 1840a (NSW); Mt Wood Hills, Sturt N.P., Sep 1989, *Reilly* 05/JR (NSW); Peery, NE of White Cliffs, Mar 1975, *Stanley* 1632 (NSW). **Tasmania**. Mt Brown, 32 km NE Hobart, May 1898, *Tate* s.n. (AD).

* These specimens have some intermediate characteristics (see discussion on variation).

Distribution and habitat: *R. helichrysoides* subsp. *helichrysoides* is found throughout inland Australia, in all mainland states across 17 degrees of latitude, in a wide variety of habitats (Fig. 2).

Phenology: Flowers throughout the year depending on rainfall.

Rutidosis helichrysoides subsp. **acutiglumis** (W.R.Philipson) A.E.Holland, **comb. nov.**

R. acutiglumis Philipson, J. Bot. 76: 316 (1937). **Typus:** Queensland. LEICHHARDT DISTRICT: Marathon Station, West of Hughenden, *Hubbard* 7772 (holo: K, photo: BRI).

Capitula with involucral bracts less than 0.8 mm wide, flat or slightly wrinkled, pale brown, entire or with very short cilia less than 0.2 mm long.

Selected Specimens: **Northern Territory**: 40 miles [64 km] NNW of Creswell Stn, July 1948, *Perry* 1684 (AD, BRI, CANB). **Queensland**. GREGORY NORTH DISTRICT: 89 km N of Bedourie towards Boulia, July 1990, *Milson* JM28 (BRI); 4 km NE Corfield, Apr 1986, *Neldner & Stanley* 2394 (BRI); Site H75, c. 27 km E of Cluny, Sep 1978, *Purdie* 1450 (AD, BRI). GREGORY SOUTH DISTRICT: 58 km E of Monkira, Sep 1989, *Cowan & Bushell* 102 (BRI); Betoota Rd., 50 miles (80 km) Rosebeth Stn, June 1972, *Johnson S.N.* (BRI); Dig Tree, Nappa Merry Stn, Coopers Ck, Mar 1990, *Sandercoe* 4031 (BRI). SOUTH KENNEDY DISTRICT: 2 km N of Natal Downs, May 1991, *Neldner & Thompson* 3122 (BRI); MITCHELL DISTRICT: E of Jericho, Apr 935, *Blake* 10233 (BRI); 5.5 km from Jundah towards Stonehenge, Sep 1989, *Wilson & Pickering* 380 (BRI).

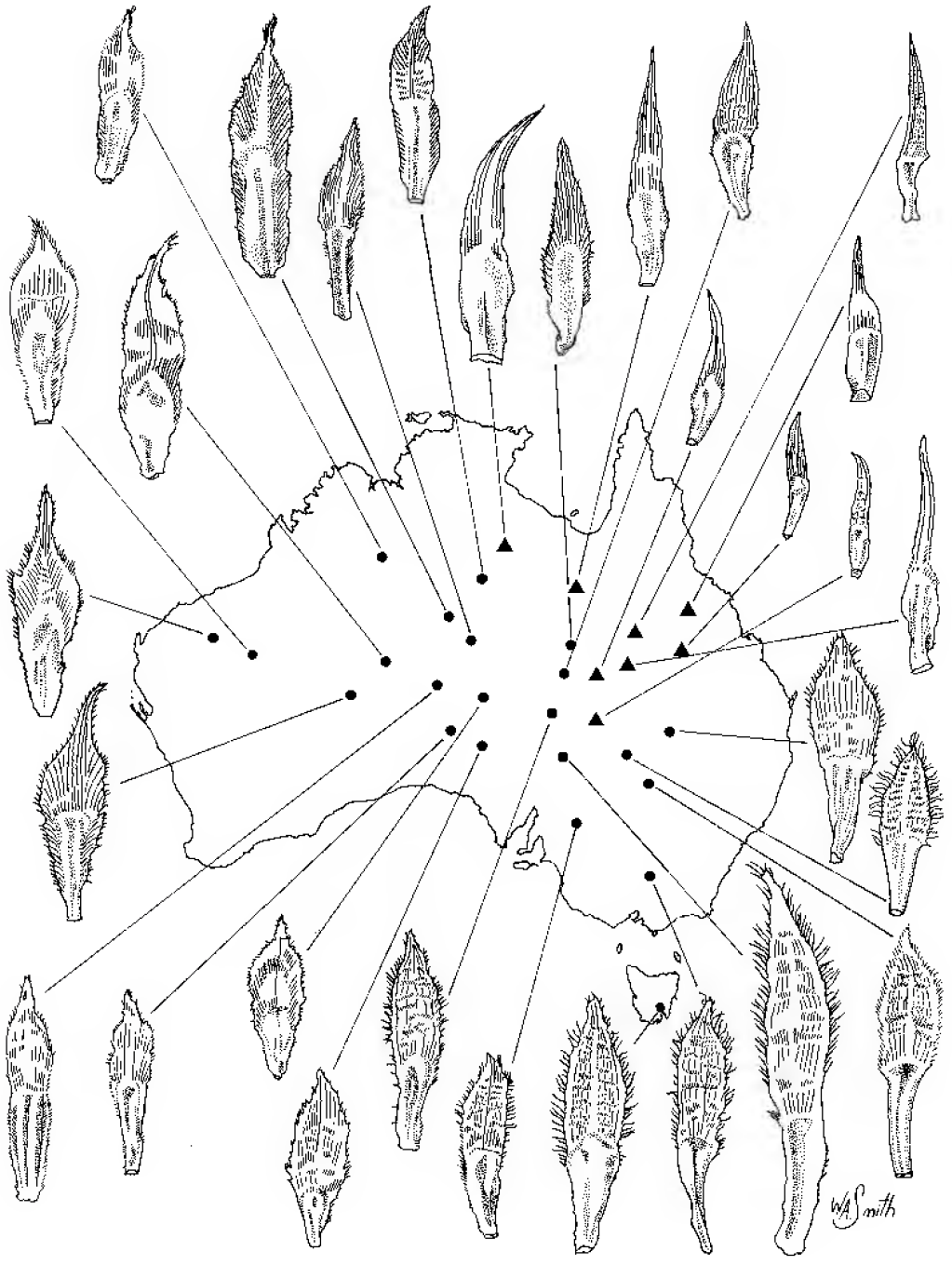


Fig. 2. Variation in involucral bract characters over the geographical range of *R. helichrysoides*, ● *R. helichrysoides* subsp. *helichrysoides*, ▲ *R. helichrysoides* subsp. *acutiglumis*.

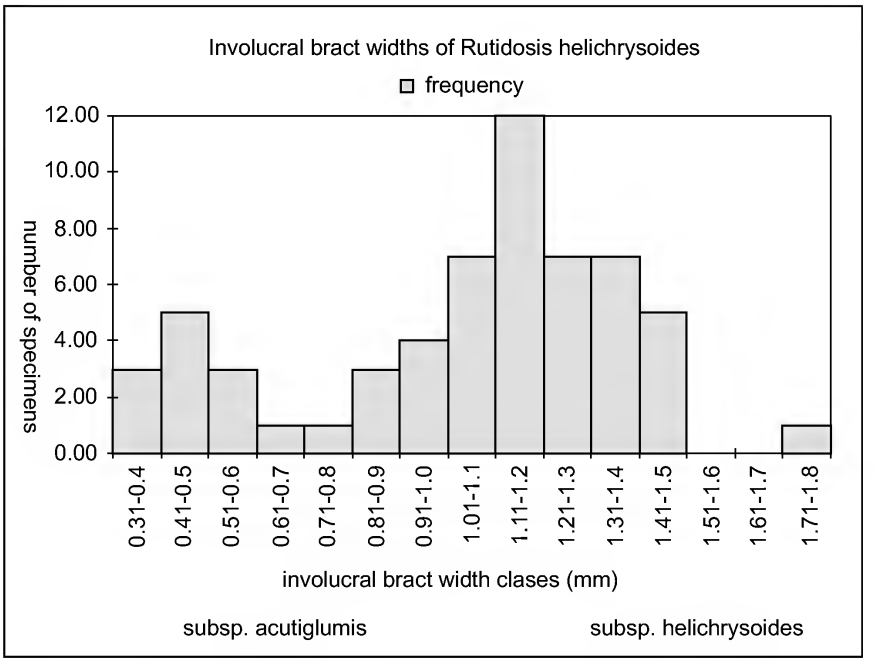


Fig. 3. Involucral bract widths for 60 specimens of *R. helichrysoides*. The widest bract for each capitulum was measured.

***Distribution and habitat*:** *R. helichrysoides* subsp. *acutiglumis* occurs in western Qld and in the north-eastern part of the Northern Territory, in open forest or grassland, in fine sand or clay soil. (Fig. 2)

***Phenology*:** Flowers mainly during the cooler months (May to October) depending on rainfall.

Note: *R. acutiglumis* Philipson is here recombined as a subspecies of *R. helichrysoides* based on the variation of involucral bract characters across the geographical range of the species (see discussion on variation and figs. 2 & 3).

Key to the species of *Rutidosis* in Australia

1. Peduncle scales present; style arms short and truncate; leaves usually linear or narrowly lanceolate to oblanceolate, the margins recurved, revolute or sometimes flat 2
   Peduncle scales absent; style arms long and tapered to a point; leaves usually elliptic or obovate, with flat or wavy margins 7

2. Pappus scales entire, obovate, broadly truncate at apex more than 3 mm wide . . . . . **R. helichrysoides**
   Pappus scales ciliate or irregular, rounded, acute or tapered at apex, less than 3 mm wide 3

3. Leaves 1–5 mm wide; corolla 3–5.5 mm long; mostly SE Qld 4
   Leaves less than 2.5 mm wide; corolla 5–7 mm long; NSW only 5

4. Plants densely glandular hairy, woolly hairs absent . . . . . **R. glandulosa**
   Plants woolly hairy or nearly glabrous, glandular hairs absent . . . . . **R. murchisonii**

5. Stems leafy, more than 15 cm high; pappus scales 2–3 mm long, with fimbriate to plumose hairs . . . . . **R. leptorhynchoides**
   Leaves mostly tufted at base; stems usually less than 15 cm high; pappus scales less than 2 mm long, ciliate with short hairs 6

6. Stems glabrous; pappus scales rounded at apex; receptacle 1.8–3 mm diam. . . . **R. leiolepis**
   Stems cottony hairy; pappus scales acute at apex; receptacle more than 3 mm diam. . . . . **R. heterogama**

7. Pappus scales obovate, nearly truncate at apex; capitula 14–24 mm diam.; florets white or cream, 4–6 mm long; outer involucral bracts with a distinct dark brown patch at base. . . . . **R. leucantha**
   Pappus scales linear, acute; capitula 4–16 mm diam.; florets yellow, 4–4.5 mm long; outer involucral bracts more uniformly coloured 8

8. Leaves 1.2–4.5 cm long, margins usually flat; capitula 8–16 mm diam., with more than 30 florets; outer involucral bracts woolly hairy. . . . . **R. lanata**
   Leaves 0.7–2.8 cm long, margins wavy or crisped; capitula 4–10 mm diam., with less than 22 florets; outer involucral bracts glandular, not woolly hairy . **R. crispata**

***Note*:** *Acomis* is distinguished from *Rutidosis* by the lack of a pappus.

Acknowledgements

Thanks to Will Smith for the illustrations, to Peter Bostock for the map and Latin diagnosis, and to the directors of Australian Herbaria for the loan of material.

Peperomia hunteriana (Piperaceae), a new species from the 'Wet Tropics' of north-eastern Queensland

Paul I. Forster

Summary

Forster, Paul I. (1999). *Peperomia hunteriana* (Piperaceae), a new species from the 'Wet Tropics' of north-eastern Queensland. *Austrobaileya* 5(3): 573-575. *Peperomia hunteriana* is described and illustrated. Information is provided on its distribution and habitat. A conservation status of Rare is recommended. A key to the native and naturalised species of *Peperomia* in mainland Australia is appended.

Keywords: *Peperomia hunteriana*, Piperaceae, Queensland

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Introduction

An account of the five species of *Peperomia* that occur on the Australian mainland has been previously provided (Forster 1993), as well as additional notes on *P. bellendenkerensis* Domin (Bostock & Forster 1995).

John Hunter of Coffs Harbour subsequently brought to my attention an anomalous population of *Peperomia* that he had collected in December 1994 on Mt Bartle Frere in the 'Wet Tropics' of north Queensland. Re-examination of herbarium material at BRI and QRS revealed two additional collections of the same entity including a much earlier collection by Len Brass in 1932. Both of these collections had been originally identified as *P. leptostachya* Hook. & Arn., this name being now considered a synonym of *P. blanda* (Jacq.) Knuth (Forster 1993). Examination of plants in the field followed by cultivation of both this entity and the other Australian taxa under uniform conditions has revealed that yet another species is present. This species is formally described and illustrated here as a precursor to my account of the genus in 'Flora of Australia' Volume 2.

Peperomia hunteriana P.I.Forst. **sp. nov.**, a *Peperomiae enervi* C.DC. et F.Muell., caulibus et foliis dense pilosis trichomatibus 0.4–0.8 mm longis (in illa glabris vel minute hispidis), pedunculis spicarum florentium in vivo tenuioribus (0.5–0.8 mm diametro adversum 1–1.5 mm), idemque sparse pilosis (in illa glabra) et bracteis floralibus fere ovario duplo longioribus (adversum longitudinem circa eandem), differt. **Type:** Queensland. Cook District: Wooroonooran National Park, Mt Bartle Frere, 25 October 1997, *P.I.Forster, R.Jensen & R.Booth* PIF21777 (holo: BRI; iso: MEL, QRS).

Erect, succulent herb to 10 cm high; foliage densely hairy. Leaves usually in a whorl of 3, occasionally 4-whorled; lamina obovate to orbicular, to 15 mm long, 10 mm wide, secondary venation obscure; base cuneate to rounded; apex notched, obtuse or rounded. Spike terminal, solitary or with up to 5 branches, to 5 cm long; peduncle 5–12 mm long; fertile axes 0.5–4.5 cm long. Flowers slightly sunken into axis, spaced 1–1.5 mm apart; bracts rounded, 0.4–0.5 mmlong, 0.4–0.5 mm wide. Anthers c. 0.4 mm long, 0.3 mm wide. Ovary rounded, 0.2–0.3 mm long, 0.2–0.3 mm diam. Drupes not seen. Fig. 1.

Additional specimens examined. **Queensland.** Cook District: Slopes of Mt Demi, Feb 1932, *Brass* 2084 (BRI); Black Mtn, Daintree Natl. Park, May 1998, *Forster* PIF22960 et al. (BRI, QRS); Bartle Frere, Dec 1994, *Hunter* JH1621 (BRI); Mt Lewis forestry road, Mar 1999, *Jago* 5144 (BRI); Summit area of Mt Lewis, Sep 1977, *Powell* 783 & *Armstrong* (BRI).

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Distribution and habitat: *P. hunteriana* is endemic to the 'Wet Tropics' of north-eastern Queensland and has been collected from four localities. Plants grow as lithophytes on exposed granite outcrops adjacent to, or within simple, microphyll to notophyll vineforest at altitudes between 1100–1520 m.

Notes: This species appears nearest to *P. enervis* but is immediately distinguishable by the copious indumentum on the foliage comprising trichomes 0.4–0.8 mm long (versus glabrous or minutely hispid), the thinner peduncles of the flowering spike in live material (0.5–0.8 mm diameter versus 1–1.5 mm) that are also sparsely hairy (versus glabrous) and the floral bracts that are nearly twice the length of the ovary (versus about the same length). The leaf lamina also tends to be more obovate in *P. hunteriana* as opposed to the largely oblong ones encountered in *P. enervis*. These differences are maintained when plants are cultivated under similar conditions.

The native and naturalised species of *Peperomia* in mainland Australia may be distinguished with the following key. Species authorship may be found in Forster (1993).

1 Leaves alternate 2
Leaves opposite or whorled 3

2 Leaves 3-nerved at base, foliage with scattered trichomes ..... **P. bellendenkerensis**
Leaves 5-nerved at base, foliage glabrous ..... **P. pellucida**

3 Leaves in whorls of 4 ..... **P. tetraphylla**
Leaves opposite or in a whorl of 3 4

4 Leaves opposite ..... **P. blanda**
Leaves usually in a whorl of 3 5

5 Stems and leaves with dense trichomes ..... **P. hunteriana**
Stems and leaves glabrous or minutely hispid ..... **P. enervis**

Conservation status: *Peperomia hunteriana* is an inconspicuous species and poorly collected. It is probably not infrequent at higher altitudes in the 'Wet Tropics'; however, further survey work is necessary to confirm this.

Etymology: Named for John Hunter of Coffs Harbour, N.S.W. who discovered this species during a vegetation survey of Mt Bartle Frere and vicinity for the Queensland Herbarium and brought it to my attention.

Acknowledgements

J.Hunter provided material of *P. hunteriana* and information on plants in habitat. P.D.Bostock provided the Latin translation of the diagnosis. R.Russell (QPWS) organised helicopter access to remote areas of the Daintree National Park. Assistance with fieldwork on Mt Bartle Frere and Black Mountain was provided by R.Booth, J.Hunter, R.Jago and R.Jensen. The artwork was executed by W.Smith (BRI).

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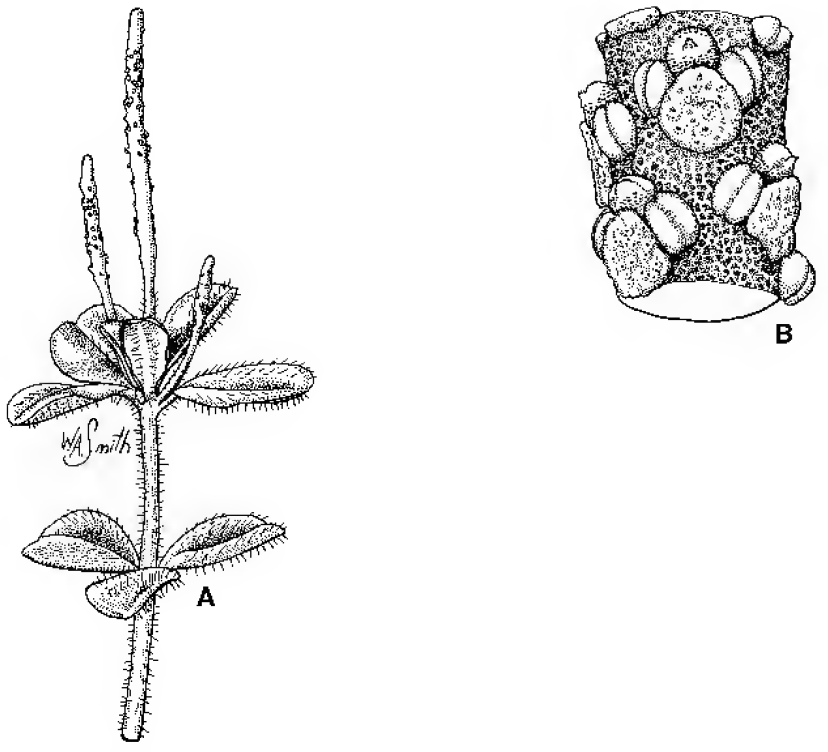

Fig. 1. ***Peperomia hunteriana.*** A. habit of flowering stem x 3.5. B. close up of inflorescence with several flowers x 24. From live material of the clonotype. Del. W. Smith.

Note

Typification and application of the name *Macrozamia macleayi* Miq. (Zamiaceae)

An account of *Macrozamia* has been recently provided by Hill (1998). Unfortunately some names have not been adequately typified in that account and one of these, *Macrozamia macleayi* Miq., is addressed in this note. The name *M. macleayi* is currently included in the synonymy of *M. miquelii* by Johnson (1959) and Hill (1998), although neither author saw type material. Typification of *M. macleayi* is important as it potentially becomes the correct name for the taxon known as *M. miquelii* (F.Muell.) A.DC. if conservation of this name with a conserved type is unsuccessful (Forster 1999).

The name *M. macleayi* Miq. was based on a type collected from Moreton Bay by Macleay (quoted in Miquel (June 1868), reprinted (Oct 1868) as "Nascitur in Nova Hollandia orientali, in regione fl. Moreton, ubi probabiliter detexit Mac Leay"). Two species of *Macrozamia*, namely *M. miquelii* and *M. lucida* L.A.S.Johnson are present in this region, hence it is essential that application of the name *M. macleayi* is resolved. Miquel's collections are housed at Utrecht (U) and a loan request produced a number of sheets of pressed *Macrozamia* fronds. There would appear to be only one likely specimen for type of *M. macleayi*, namely the sheet U028258 with the scant label data of "Moreton Bay", no date and no collector. This specimen, labelled as *M. macleayi* in Miquel's hand, comprises a single pressed frond typical of immature *M. miquelii* (*sensu* Hill 1998) as found at Mt Glorious near Brisbane (probably equivalent to "Moreton Bay" of the 1860's). Other specimens from Utrecht that are also labelled as *M. macleayi* are obviously from cultivated plants (e.g. U028255, V.Houtte No. 14, Oct [18]68).

Macrozamia macleayi Miq., Arch. Néerl. Sci. Exact. Nat. 3(5): 250 (post 16 June 1868) & Miq., Adansonia 9: 69 (22 Oct 1868). **Type:** [Queensland. Moreton District:] Moreton Bay, s.coll., s.dat. (holo: U028258!).

Acknowledgements

Thanks to P.D.Bostock for comments on the manuscript and to the Herbarium, State University of Utrecht for loan of specimens.

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Note

In defence of *Chrysopogon fallax* S.T.Blake (Poaceae)

In another contribution in this issue of *Austrobaileya*, Dr Veldkamp (Veldkamp 1999) has treated *Chrysopogon fallax* S.T.Blake (1944) as an illegitimate synonym of *C. benthamianus* Henrard (1941). In addition, Dr Clayton (Clayton 1999 and ongoing) uses the name *C. benthamianus* rather than *C. fallax* in his World Grasses Database on the world wide web. I consider *C. benthamianus* Henrard is not validly published and without standing under the International Code of Botanical Nomenclature (ICBN)(Greuter et al., 1994) whereas *C. fallax* is validly published, legitimate and correct for the species concerned under the ICBN.

Neither Brown (1810) nor Bentham (1878) intended publishing nor did publish a name distinct from *Andropogon gryllus* L. for a species of Poaceae. Both were enlarging their concept of Linnaeus's species *Andropogon gryllus*, under the generic names *Holcus* [Brown] or *Chrysopogon* [Bentham], to include Australian material they considered belonged in that species. That is, to both Brown and Bentham, Linnaeus's name applied not only to his species but also to the Australian material they included in it. As well, Bentham accepted that Linnaeus's species also included, as a variety, material that Brown had included in *Holcus pallidus*, Roemer and Schultes (1817) later included under *Pollinia pallida* and Kunth (1829) included under *Andropogon pallidus*. Bentham considered this species (as *Chrysopogon gryllus* (L.) Trin.) to be "widely spread over the tropical and warmer temperate regions of the Old World".

The type of the name *Chrysopogon gryllus* (L.) Trin. as used by Bentham, and the name *Holcus gryllus* (L.) R.Br. is the same as the type of *Andropogon gryllus* L., *Cent. II Pl.* 33 (1756) (ICBN, Art. 7.4). Specimens cited by Bentham under *Chrysopogon gryllus* (L.) Trin. in 1878 have no bearing on typification of the name *Andropogon gryllus* L.

Hubbard (1938) and Henrard (loc. cit.), who apparently based his opinion mainly on Hubbard's published statements but also on others by Hackel (1889) and Pilger (1940), and also Blake (loc. cit.) all accepted that the taxon Bentham described under the name *Chrysopogon gryllus* did not include the type of Linnaeus's name *Andropogon gryllus* (and consequently of *Holcus gryllus* (L.) R.Br.), or the type of *Holcus pallidus* R.Br. They, in fact, accepted that Linnaeus's name with reference and Brown's two names with references, did not apply to Bentham's taxon.

In naming the taxon described by Bentham under *Chrysopogon gryllus*, Henrard (loc. cit.) stated that he treated only the part covered by Bentham's description as *C. benthamianus*. ("Bentham's *Chrysopogon Gryllus*, being described, we can give it another name: Chrysopogon Benthamianus Henr. nom. nov. See Bentham Fl. Australiensis Vol. VII (1878) p. 537.").

Note should be taken here that Henrard was not providing a new name in the usual botanical sense of the words 'nom. nov.' to replace a previously validly published but illegitimate or potentially illegitimate name, but was providing a name to go with a previously published English description of a particular taxon he recognised. ICBN, Art. 33 is not, therefore, applicable in this situation, but Art.36 of the Code is.

Two queries arise when considering the name *Chrysopogon benthamianus*: is the name validly published and, if so, what is its type?

Henrard did not provide a Latin description with his name for this taxon, so to meet the requirements for valid publication of

this name in 1941, under Art.36.1 of the ICBN, he had, as an alternative, to provide a reference to a previously and effectively published Latin description or diagnosis. Henrard did refer to 'Bentham Fl. Australiensis Vol. VII (1878) p. 537.' when proposing *C. benthamianus* but Bentham did not provide a Latin description or diagnosis there. Thus, since Henrard did not provide the mandatory Latin description or diagnosis or reference to such, his name *C. benthamianus* is not validly published and without standing under the ICBN.

Though not supplying a Latin description or diagnosis in 1878, Bentham did provide references to a number of previously and effectively published Latin descriptions relating to what are now considered more than one distinct species. It has been past practice to accept the current wording of Art. 36.1 to allow for indirect reference to a Latin description to satisfy the requirements of this Article but in those cases, the Latin description usually has been taken as one referring to the taxon concerned.

Henrard implied, by omission and the acceptance of *Chrysopogon gryllus* (L.) Trin. (page 531) and *Chrysopogon pallidus* (R.Br.) Trin. (page 531) as distinct species, that he accepted that none of the names with references cited by Bentham applied to the taxon he named *Chrysopogon benthamianus*. Thus, material associated with those previously published names is irrelevant to validation of Henrard's name.

For the suggestion that reference to Bentham, who quoted as a synonym of *Chrysopogon gryllus* Brown's name *Holcus gryllus* (L.) R.Br. and its place of publication, validated Henrard's *Chrysopogon benthamianus* to be plausible, Henrard would have to have specifically included the reference to Brown's validation of *Holcus gryllus*, then excluded the reference to Linnaeus's *Andropogon gryllus*, and hence its type which is also type of Brown's *Holcus gryllus* (ICBN, Art.52.1&2). Henrard did not do that.

Perhaps it could be argued that Art.36.1 of the ICBN should be interpreted to mean that a Latin description or diagnosis of any taxon related to Bentham's account, even if of a quite different species such as *Andropogon gryllus* L. or *Holcus pallidus* R.Br., is effective in validating *Chrysopogon benthamianus*. This seems quite nonsensical and is not what is intended by Article 36.1 of the ICBN.

Because of the foregoing, I continue to consider Henrard's name *Chrysopogon benthamianus* not validly published and hence without standing under ICBN (Art.6.6). There is, therefore, no need to consider what is/may be a type specimen for this name.

On the other hand, Blake (loc. cit.) took all the correct steps to validate his *Chrysopogon fallax*. He gave a Latin description of the taxon, nominated a holotype for his name, cited the location of the holotype and discussed how the species differed from *Chrysopogon gryllus* (L.) Trin. In doing the last, he effectively excluded the type of *Andropogon gryllus* L., and thus *Holcus gryllus* (L.) R.Br. and *Chrysopogon gryllus* (L.) Trin., from his concept of *C. fallax*. He excluded Brown's type of *Holcus pallidus* from the species by accepting *Chrysopogon pallidus* (R.Br.) Trin. ex Steud. as a species distinct from *Chrysopogon fallax* (Blake loc. cit., p.14).

In his discussion of *Chrysopogon fallax*, Blake listed a large number of references by many authors which he stated related "wholly or in part to this species". There, he cited what he believed was applicable to *C. fallax* under the botanical name that the author used in each of those references, i.e. *Holcus gryllus* (L.) R.Br., *Chrysopogon gryllus* (L.) Trin., *Andropogon gryllus* L., *Chrysopogon gryllus* subsp. *pallidus* (R.Br.) Domin or *Chrysopogon gryllus* subvar. *pilosus* Domin. For some of these references, he specified the part of it he considered pertinent. Though this was not the case with Bentham's reference to *Chrysopogon gryllus*, Blake did state that only the description in, and specimens associated with, Brown's account of *Holcus gryllus* related to *Chrysopogon fallax*. Because of the way Blake treated these names elsewhere in his paper, none of the species names in these references can be considered to have been included by Blake as a synonym of *Chrysopogon fallax* thereby rendering it illegitimate.

For these reasons, I consider Blake's name *Chrysopogon fallax* to be both validly published and legitimate. I also believe it to be the correct name for the plant concerned.

Acknowledgments

I wish to thank both Bryan Simon and Les Pedley for their critical comments on earlier versions of this note.

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Note

Steinchisma hians (Elliott) Nash, the correct name for *Fasciculochloa sparshottiorum* B.K.Simon & C.M.Weiller

When the grass *Fasciculochloa sparshottiorum* was described (Simon & Wheeler, 1995), isotypes were distributed to many Australian and international herbaria listed under the protologue description. The specimen sent to the herbarium of the Missouri Botanical Gardens (MO) was recently examined by its Curator of Grasses, Dr Gerrit Davidse, who provided me with his observations of the specimen.

"The genus and species you described as *Fasciculochloa sparshottiorum* immediately seemed familiar to me and upon a closer look under the dissecting microscope, seemed exactly like the widespread American *Steinchisma hians* (*Panicum hians*). I notice that in your paper you did not compare your material to this species, but they must surely be the same. They also grow in the same kind of habitat, judging by the photo in your paper. I would not be surprised that this may a recent introduction. Is that a possibility?"

I was able to confirm Dr Davidse's conclusions regarding this taxon from a comparison with three specimens of this species from the New World in BRI (*S.M. Tracy s.n* from Starkville, Missouri; *R.L. Crockett 6871* from Jefferson County, Texas (ex US); T.B. Ryves 69 from Freer, Texas).

An isotype was also sent on loan in 1998 to the Instituto de Botanica Darwinion, San Isidro, Argentina for examination by Dr Fernando Zuloaga and colleagues, as part of an ongoing cladistic study of the grass tribe Paniceae (Zuloaga, Morrone and Giussani 1998). This author and colleagues had undertaken a cladistic study of the genus *Steinchisma* in early 1997, published in 1998 (Zuloaga, Morrone, Vega & Giussani 1998). Although they suspected that *Fasciculochloa* was similar, or identical, to *Steinchisma* (Zuloaga, pers. com.) at the time they had not seen the type of *Fasciculochloa sparshottiorum*, and thus did not formally place *Fasciculochloa* in synonymy under *Steinchisma*. The most recent cladistic analysis of the Paniceae (Zuloaga, Morrone and Giussani in press), indicates clearly that *Fasciculochloa* and *Steinchisma* are the same taxon.

Steinchisma hians is widespread in the New World, occurring in the southern and eastern United States (Hitchcock & Chase 1951, as *Panicum hians*) and in Mexico, Central America, Colombia, Brazil, Bolivia, Paraguay, Uruguay and Argentina (Fig 6 in Zuloaga, Morrone, Vega & Giussani 1998). It generally grows in wet habitats. There is a good illustration of it in Fig. 8 of the 1998 paper of Zuloaga et al.

Steinchisma hians is the type of *Steinchisma*, published in 1830 by Rafinesque. Taxonomically the genus has had rather a chequered history of being placed in *Panicum*, as a section or subgenus of *Panicum* (Zuloaga 1987) or as a genus in its own right (Brown 1977, Clayton & Renvoize 1986, Renvoize 1998, Zuloaga, Morrone, Vega & Giussani 1998). Currently it is recognised as a distinct genus on cladistic evidence (Zuloaga, Morrone, Vega & Giussani 1998). The synapomorphies by which members of the genus are recognised include the leaf blade characters of the number of chlorenchyma cells (5-7) between the vascular bundles and the presence of chloroplasts in the parenchyma sheath. Distinguishing morphological characters are "the expanded lower palea and the presence of verrucose papillae all over the upper anthoecium" although the latter "do not show as apomorphic characters in the cladistic analysis because these characters are also present in a related genus, *Plagiantha*." (Zuloaga, pers. com.).

The date and point of entry of this New World grass species to Australia is of interest, in view of the fact that it has not been reported before on this continent. There is a possibility that it could date back to the days of World War 2, as there was a large contingent of American troops encamped near the area of collection at that time. However, the fact that it has not become more widespread since then may point to a more recent arrival in Australia. In support of this hypothesis is the circumstance of its presence in South Africa. It has been reported as occuring in that country in the last decade (Gibbs Russell et al 1990, as *Panicum hians*), but it is not recorded in a previous account of South African grasses (Chippindall 1955).

Acknowledgments

I thank Gerrit Davidse for drawing my attention to this matter, and to Fernando Zuloaga and Rod Henderson for reviewing the manuscript and suggesting changes to it.

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Review

B.P.M. Hyland, T. Whiffin, D.C. Christophel, B. Gray, R.W. Elick and A.J. Ford (1999). ***Australian Tropical Rain Forest Trees and Shrubs***. *An interactive plant identification system for trees and shrubs.* CD-ROM and 95-page manual. CSIRO Publishing. Price $130. ISBN 0 643 06047 2.

This publication is a further, major advance upon the landmark computer-based identification system published by Bernie Hyland and Trevor Whiffin in 1993. That publication was reviewed for this journal by Carolyn Hohnen (Hohnen 1994), who traced the development of this system from the original card key of 1971, which covered the more common rainforest trees of the Wet Tropics between Townsville and Cooktown. The 1993 publication included 1056 tree species across all of tropical Australia, north of 19°S.

One of the major drawbacks to its use was the exclusion of small trees and shrubs less than 6 m high and/or 10 cm diameter at breast height. Collection of suitable material, ie. from canopy and sub-canopy trees can be a very difficult and slow procedure; moreover, at a particular location many canopy species may be represented only by juveniles. This has limited its value for field studies. These restrictions have been removed by the present publication which has included rainforest shrubs and sub-shrubs, making a total of 1733 species.

The other major improvement to the system is the inclusion of distribution maps and images for each species. The maps display point locations for herbarium specimens held at the Australian National Herbarium, Atherton (QRS) and the Northern Territory Herbarium, Darwin (DNA) and are more informative than a generalised range. Apart from incorporating the x-ray leaf images from Volume 2 of the 1993 publication, there are also photographs of flowers of most species and where available, the wonderful fruit and flower paintings by William Cooper. Importantly, these images are also linked with vouchered herbarium specimens.

The system requires a computer with a 486 or Pentium processor and Microsoft Windows 3.1 or later. It also needs at least 8 megabytes of RAM (16 mb for Windows 95) and approx. 10 mb of hard disk space (images are left on the CD-ROM) or 1 mb if the program is run entirely from the CD-ROM. I found it ran quite satisfactorily, with minimal delays, on a Pentium 90 machine.

The key is straightforward to use, with individual screens for each of the major groups of characters, viz. habit, bark, leaf, flower, fruit, seedling, family and geographic range. Separate screens list the (decreasing) subsets of possibilities and the set of characters scored for the specimen. This latter feature has been added since the 1993 version, and is a great help in further checking of identifications.

Images and maps are accessed via the list of possibilities. There is also access to a detailed description of each species and a list of the key characters for each species, which is particularly valuable for checking against the characters scored for the specimen being identified.

The key comprises 17 bark characters (48 states or features), 27 leaf characters (106 features), 40 flower characters (166 features), 16 fruit characters (64 features) and 34 seedling characters (86 features). Specimens may also be scored for family and geographic location, ie. north-western Western Australia, Northern Territory, Cape York (ie. 16° northward) and north-eastern Queensland (south to 19°S). The User Guide provides excellent illustrations of character states, eg. leaf apices and bases, and definitions and explanations are provided in help menus for each character set and as context-sensitive help for each feature.

As a field botanist, I depend mainly on leaf (and branchlet) characters and stem surface features to identify rainforest trees. I would like to see a greater range of leaf characters included, such as presence and types of indumentum, stipules, bracts and scales, glands on petioles and/or laminas, presence and colour of latex, etc..

I have had relatively few difficulties in using the key. Oil dots (their presence or otherwise) often create problems and I was unable to key out *Eupomatia laurina.* This species is recorded in the Additional Features menu as having "very small oil dots just visible with a lens", but is coded only for "oil dots absent".

This product is not really a practical field tool. Although it can be used in a laptop computer, this value is restricted by extremely limited battery lives (except where generators are available) and weather conditions. There remains a place for old-fashioned hard-copy field guides compiled at the regional or local level.

Having said that, I unreservedly recommend this guide to professional and amateur biologists alike. Apart from its identification role, the guide is a marvellous information system for anyone with a serious interest in the rainforest flora of northern Australia It will be further enhanced in the next few years by incorporation of rainforest vines and climbers.

Reference

HOHNEN, C. (1994). Book Review: *Australian Tropical Rainforest Trees - An interactive identification system,* including *Leaf Atlas of Australian Rain Forest Trees. Austrobaileya* 4(2): 291–292.

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Austrobaileya 5(3): 587 (1999)

Corrections

Austrobaileya 5(2): 1999

p.221 line 14 column 1. *Dendrolobium polyneurum*

The combination had been made previously: *Dendrolobium polyneurum* (S.T. Blake) Ohashi, Taiwania 43: 102 (1998).

p.257 line 50 column 2. *Phyllodium pulchellum* var. *glabrius* Pedley

The number of the type collection should be changed from *C.R. Dunlop* 976 & *G Leach* to *C.R. Dunlop* 7976.

p.292 line 46 column 2. *Boronia duiganiae* Duretto

The number for the isotype at BRI should be changed from AQ121206 to AQ151206.

p.319 line 10. column 1.

The spelling of the name *Acacia scopularum* should be changed to *Acacia scopulorum* Pedley.

Index of new names published in Austrobaileya 5(3)

Bridelia finalis P.I.Forst., sp. nov. 408
Camarophyllopsis kearneyi A. M. Young, sp. nov 562
Capillipedium leucotrichum (A. Camus) Schmid ex Veldk., comb. nov. 527
Chrysopogon celebicus Veldk., sp. nov. 511
Chrysopogon festucoides (Presl) Veldk., comb. nov. 512
Chrysopogon fulvibarbis (Trin.) Veldk., comb. nov. 525
Chrysopogon intercedens Veldk., sp. nov. 515
Chrysopogon lawsonii (Hook.f.) Veldk., comb. nov. 515
Chrysopogon micrantherus Veldk., sp. nov. 516
Chrysopogon nigritanus (Benth.) Veldk., comb. nov. 526
Chrysopogon oliganthus Veldk., nom. nov. 526
Chrysopogon rigidus (B.K. Simon) Veldk., comb. nov. 527
Hygrocybe anomala var. *ianthinomarginata*, A. M. Young, var. nov. 551
Hygrocybe austropratensis A. M. Young, sp. nov. 546
Hygrocybe cheelii A. M. Young, nom. nov. 547
Hygrocybe lanecovensis A. M. Young, sp. nov. 558
Mallotus dispersus P.I.Forst., sp. nov. 465
Mallotus megadontus P.I.Forst., sp. nov. 470
Mallotus surculosus P.I.Forst., sp. nov. 488
Ochrosperma obovatum A.R.Bean, sp. nov. 499
Peperomia hunteriana P.I.Forst., sp. nov. 573
Rhodamnia angustifolia N.Snow & Guymer, sp. nov. 421
Rutidosis glandulosa A.E.Holland, sp. nov. 565
Rutidosis helichrysoides subsp. *acutiglumis* (N.R.Philipson) A.E.Holland, com. nov. 569
Stylidium austrocapense A.R.Bean, sp. nov. 442
Stylidium delicatum A.R.Bean, sp. nov. 434
Stylidium foveolatum A.R.Bean, sp. nov. 430
Stylidium paniculatum (Maiden & Betche) A.R.Bean, comb. et stat. nov. 446
Stylidium velleioides A.R.Bean, sp. nov. 448

Queensland Herbarium

Publications for sale

Floras

A Key to Australian Grasses by B.K. Simon (1993), 2nd edition 206 pp., card cover.

Ferns of Queensland by S.B. Andrews (1990), 427 pp., illustrated, hard cover.

***Honey Flora of Queensland*, 3rd edition** by S.T. Blake and C. Roff (1988), 224 pp., illustrated, card cover.

Flora of South-eastern Queensland by T.D. Stanley and E.M. Ross.

Volume 1 (1983), 545 pp., illustrated, card cover.

Volume 2 (1986), 623 pp., illustrated, hard cover.

Volume 3 (1989), 532 pp., illustrated, hard cover.

Vegetation Surveys

Vegetation Survey of Queensland: South West Queensland. Queensland Botany Bulletin No. 4 by D.E. Boyland (1984), 151 pp., illustrated, including a map, card cover.

Vegetation Survey of Queensland: South Central Queensland. Queensland Botany Bulletin No. 3 by V.J. Neldner (1984), 291 pp., illustrated, including a map, card cover.

Vegetation Survey of Queensland: Central Western Queensland. Queensland Botany Bulletin No. 9 by V.J. Neldner (1991), 230 pp., illustrated, including a map, card cover.

Vascular Plants of Western Queensland. Queensland Botany Bulletin No. 11 by V.J. Neldner (1992), 176 pp., illustrated, card cover.

Vegetation of the Sunshine Coast: Description and Management. Queensland Botany Bulletin No. 7 by G.N. Batianoff and J.A. Elsol (1989), 107 pp., illustrated, including maps, card cover.

Vegetation Map and Description, Warwick, South-eastern Queensland. Queensland Botany Bulletin No. 8 by P.A.R. Young and T.J. McDonald (1989), 47 pp., illustrated, including a map, card cover.

Vegetation Description and Map: Ipswich, South-eastern Queensland. Queensland Botany Bulletin No. 10 (1991), by James A. Elsol, 61 pp., maps, card cover.

Vegetation Survey and Mapping in Queensland: Its Relevance and Future, and the Contribution of the Queensland Herbarium. Queensland Botany Bulletin No. 12 by V.J. Neldner (1993), 76 pp., card cover.

Economic Interest

Suburban Weeds, Third edition by H. Kleinschmidt, A. Holland and P. Simpson (1996), 98 pp., illustrated, card cover.

Use of Fodder Trees and Shrubs by S.L. Everist (1986), 72 pp., illustrated, card cover.

Poisonous Plants - a field guide by R.M. Dowling and R.A. McKenzie (1993), 175 pp., colour illustrations and maps, card cover.

Special Interest

Rare and Threatened Plants of Queensland, 2nd edition by M.B. Thomas and W.J.F. McDonald (1989), 76 pp., card cover.

The Flora of Girraween and Bald Rock National Parks by Bill McDonald, Colleen Gravatt, Paul Grimshaw and John Williams (1995), 100 pp., colour and line drawing illustrations and maps, card cover.

Wildflowers of South-eastern Queensland by B.A. Lebler.

Volume 1 (1977) 108 pp., illustrated, soft cover.

Volume 2 (1981) 83 pp., illustrated, soft cover.

Enquiries regarding the cost and ordering of these publications should be directed to Queensland Herbarium, Environmental Protection Agency, Brisbane Botanic Gardens Mt. Coot-tha, Mt. Coot-tha Road, Toowong Qld 4066.